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WITH

International Abstract of Surgery

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—Journal A. M. A., January 1, 1921, page 33.

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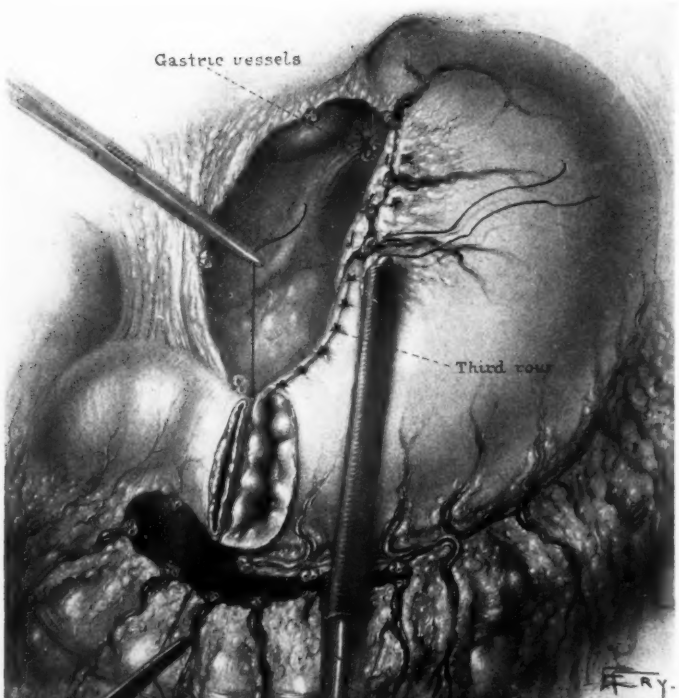

Fig. 3. Third stage of Billroth I operation for resection of the stomach. Posterior musculoserous suture uniting duodenum and stomach.

Radical Operations on the Stomach with Especial Reference to Mobilization of the Lesser Curvature.—W. J. Mayo.

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RADICAL OPERATIONS ON THE STOMACH WITH ESPECIAL REFERENCE TO MOBILIZATION OF THE LESSER CURVATURE[1]

BY WILLIAM J. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

THE foundation of modern gastric surgery was the exploratory incision. Sometimes, however, because of the nature of the disease the acid test of the knife was not considered justifiable until a stage in which the exploratory incision confirmed a bad prognosis in patients for whom earlier diagnosis would have been life-saving. To a degree this statement is true at the present day, although new diagnostic methods are resulting in much earlier diagnoses.

The newer knowledge which has come largely from the laboratory has been of such diagnostic importance in special fields that practitioners have become more or less dependent on laboratory tests for the development of many facts formerly derived without them. To a certain extent this dependence has led to the disuse and even to the abandonment of time-honored clinical methods which converted the practitioner's knowledge into wisdom, and consequently clinical acumen has suffered. I have been surprised to note the readiness with which high-grade young men, graduates from medical institutions which are models for our time, yield to the temptation of machine-made diagnoses. A few show an unfortunate willingness to start the patient off on a round of impersonal laboratory examinations before making thorough physical examinations and recording clinical findings. There is an apparent disregard of details of special importance to the clinician, an exaggeration of the importance of minor details, and an undue reliance on diagnostic pfennigs, which leave out of account the personal equation presented by the patient himself. The young medical graduate often shuns individual responsibility, and the majority no longer care for independent practice. The general practitioner feels that his day has passed.

In the Clinic, the diagnosis with such aid as the clinician himself can reasonably be expected to employ precedes all laboratory examinations, and this clinical diagnosis is recorded. All laboratory methods that appear to be necessary are then employed and used to check the clinical diagnosis. In this manner the competent clinician, by the use of eye, hand, and ear, aided by the various scopes, speculæ, stomach tube, and so forth, will make accurate diagnoses in from 80 to 85 per cent of cases, on an average. Checking by laboratory methods will modify clinical diagnoses by additional data in from about 10 to 15 per cent. If a machine diagnosis is made first and supplemented by a clinical diagnosis the accuracy in end-result will be greatly reduced.

Among all the additions to diagnostic resources that have been made in this generation, the roentgenograph is of first importance. The sense of sight in this field has brought order out of confusion and separated facts from fancies. We are indebted to the

[1] Read before the Western Surgical Association, Minneapolis, December 8 and 9, 1922.

roentgenographer for a great extension of gastric surgery. It must be remembered, however, that the roentgenograph is not a picture of the object itself but a picture of its shadow. Carman has repeatedly called attention to the fact that the roentgenographic examination must be correlated with the clinical examination in order to attain its greatest usefulness. The roentgenograph, in the hands of experts, will insure correct diagnoses in from 90 to 95 per cent of cases of gastric lesions. While the roentgenographer is able to determine that a lesion does, or does not exist in the stomach, he is unable, in a very high percentage of cases, to determine the extent of a carcinomatous process in the glands or the tissue outside the stomach. That which to him may appear to be operable may prove, on exploration, to be inoperable, and that which appears to him inoperable, on exploration may prove to be the contrary.

Too often the diagnostician throws the entire diagnostic burden on the roentgenograph instead of using it as an aid to and an extension of the clinical examination of the patient. In many instances, huge lesions of the stomach are considered, roentgenographically, to be imoperable. The patients, however, are in such good condition that clinicians are led to advise exploration, which may disclose a large tumor of the greater curvature of the stomach which is operable and curable. Movability of the growth may be more important than its extent. The patient's good general condition, suggesting adequate resistance, will lead the competent clinician to advise an exploration in a doubtful case, whereas a poor condition will incline him to the opposite opinion. I dwell somewhat on the importance of the general physical condition of the patient with relation to cancer of the stomach because of experiences which have shown that the roentgenographer and the clinician must work out these problems together in order to secure the best results.

INDICATIONS FOR RADICAL OPERATIONS ON THE STOMACH

Radical operations for cancer of the stomach have attracted the attention of surgeons for 40 years, and for the last 10 years have been resorted to with increasing frequency in cases of benign lesions of the stomach. The most experienced surgeons incline more and more to some form of partial gastrectomy in certain types of ulcer of the stomach and duodenum, while the more radical group are applying the operation to practically all ulcers of the stomach and duodenum, and claim much improvement in results.

Gastro-enterostomy will cure more than 90 per cent of duodenal ulcers, and the excellent pyloroplastic operation of Finney with excision of the ulcer will add at least 5 per cent to the successful surgical group. There remains, however, a small, but definite, group of duodenal ulcers with deep excavations which may cause severe hæmorrhages, in which gastro-enterostomy will fail to relieve the hæmorrhages and othere severe symptoms, and the pyloroplastic operation cannot well be applied. In such cases, at least, partial gastrectomy of some type is the operation of choice. The field for partial gastrectomy is much wider in cases of gastric ulcer than in cases of duodenal ulcer. Gastric ulcers are usually greater in extent. They often slowly perforate, forming excavations into the pancreas, and lead to the formation of extensive and crippling adhesions. Hæmorrhages from these deep excavations are not infrequent, and may prove fatal, and at best in the case of the larger ulcers a crippled, inefficient organ remains after excision of the ulcer with or without gastro-enterostomy. In the smaller gastric ulcers along the lesser curvature, which comprise about 75 per cent of ulcers of the stomach, the conservative cautery excision of Balfour with gastro-enterostomy has proved successful in at least 90 per cent of the cases to which it has been applied. For extensive ulcerations in the vicinity of the pylorus, the partial gastrectomy of Rodman (Billroth II) has held steady place in the esteem of the conservative surgeon. Judd has shown that gastric resection in continuity for the larger ulcers of the body of the stomach gives satisfactory results. The Billroth I and II, the Pólya, and the Balfour-Pólya methods of partial gastrectomy, all have their special

fields of usefulness. Each case must be treated on its merits, and the decision as to procedure in a given case cannot always be made until surgical exposure makes accurate examination of the lesion possible. In this equation, the general condition of the patient is important, and in many cases determines the final choice of method. Generally speaking, in cases of gastric and duodenal ulcers which relapse subsequent to conservative operation (gastro-enterostomy and so forth), partial gastrectomy is indicated. The advocate of any one type operation for all ulcers of the stomach and duodenum is basing his conclusions on a unique experience.

Following radical operations for cancer of the stomach, a 10 per cent mortality is, I believe, justifiable and gives a just operability. If I find that my mortality is running under 10 per cent, I extend the field of operability, accepting cases for operation that previously I had considered inoperable. This practice has resulted in remarkable success in certain cases. A mortality of 5 per cent following partial gastrectomy for ulcer of the stomach may, with difficulty, be justified, and yet if partial gastrectomy is applied only to cases of more advanced and extensive ulceration and cases in which relief has not been obtained subsequent to previous operations, the mortality, according to my experience, will be approximately 4 per cent. If patients in good condition whose ulcers are small are operated on, this statistical mortality can readily be brought below 3 per cent. If the surgeon's pride in his statistical results of operative mortality leads him to apply the radical operation to the easy, safe cases and to use the less radical procedure on the dangerous type of case, which perhaps could be justified from the standpoint of risk, the mortality can be diluted to 2 per cent. If, in addition, the surgeon accepts for radical operation patients in good condition, with duodenal ulcers, there is no reason why the mortality following partial gastrectomy in skilled hands cannot be reduced to less than 2 per cent, making a relatively good showing as contrasted with gastro-enterostomy and pyloroplasty.

Admitting the force of the argument that partial gastrectomy permanently removes the ulcer-bearing and acid-controlling portion of the stomach, my personal experience has not yet led me to believe that partial gastrectomy has so wide an application to peptic ulcer. On several occasions I have made primary partial gastrectomies for chronic, moderate-sized ulcers of the lesser curvature and have not been satisfied when examination of the specimens showed definite, locally removable lesions of the stomach with a great amount of normal gastric tissue sacrificed unnecessarily.

MOBILIZATION OF THE LESSER CURVATURE OF THE STOMACH

I wish to call attention to the fact that the lesser curvature is the most important portion of the stomach. In the nature of things, the cardiac fixation of the stomach is seldom an obstacle to successful operation and we know how to liberate the pyloric end, so that for practical purposes in the great majority of radical gastric operations the lesser curvature is the key to the anatomic lock which interferes with the liberation of the stomach. The anterior and posterior surfaces of the stomach are normally free. The greater curvature, including the dome, can be readily mobilized. Surgeons who have had experience in the operation of splenectomy must have noticed that practically the entire stomach from the greater curvature to the œsophagus comes into the field of vision as the spleen is withdrawn from the abdomen. If one studies the musculature of the stomach as related to the vascular and lymphatic connections of the lesser curvature, it is apparent that the bands which hold and fix this portion of the stomach can readily be seen at operation and divided. The success of the procedure depends on early ligation of the gastric artery as close as necessary to the cœliac axis, depending on the location of the growth in the stomach (Fig. 1). After separating the gastrohepatic omentum from the under surface of the liver, the distal end of the gastric artery is held taut and the artery, glands, fat, and the unyielding structures are dissected from the lesser curvature toward the pylorus, the lateral vessels being caught and tied in succession as the holding bands are cut. The lesser curvature elongates

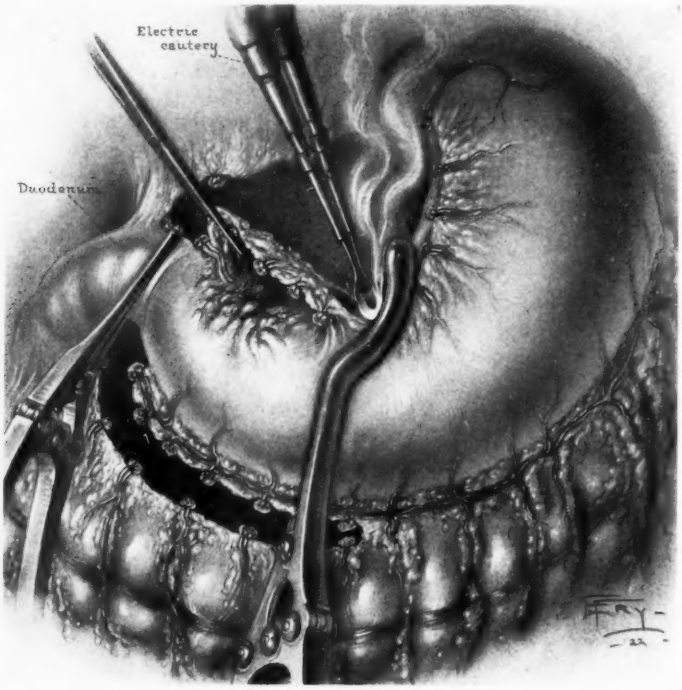

Fig. 1. First stage of Billroth operation for resection of the stomach.

remarkably, and in favorable cases snipping fibers here and there will permit the œsophagus to be drawn into view (Figs. 1 and 2) so that total gastrectomy can be performed if desired.

Mobilization of the stomach by attack on the attachments of the lesser curvature is extremely useful in operating on diverticula which are sometimes found at the œsophageal-gastric juncture, and on certain ulcers of the stomach, especially those high on the lesser curvature and posterior wall, but its greatest advantage is realized in partial gastrectomies for carcinoma. In the Clinic, following the removal of the malignant portion of the stomach we are more and more inclined in favorable cases to restore the lumen by anastomosing the end of the duodenum to the narrowed end of the stomach after the Billroth I method. This operation should not be forced. If it cannot be done easily, one of the other methods of gastrectomy should be applied. Narrowing of the stomach may be accomplished on the lesser curvature, by dissecting out the necessary portion of the lesser curvature, and suturing behind as the tissues are divided in front. Otherwise there will be difficulty in grasping and suturing the divided margins of the gastric wall as they retract. The Payr stomach clamp may be advantageously modified to aid in this manœuvre (Fig. 2). The blood vessels are caught and tied as they are cut. In this manner the necessary amount of the lesser curvature is dissected out. Experience has shown that the lesser curvature of the stomach is most vulnerable to the extension of carcinoma. Dissection of the lesser curvature at a higher point than one would ordinarily amputate is a protection against failure to eradicate the disease, as it removes the lymphatics most extensively.

METHODS OF RADICAL OPERATION

Experience with complete gastrectomies has not been sufficient to determine whether the

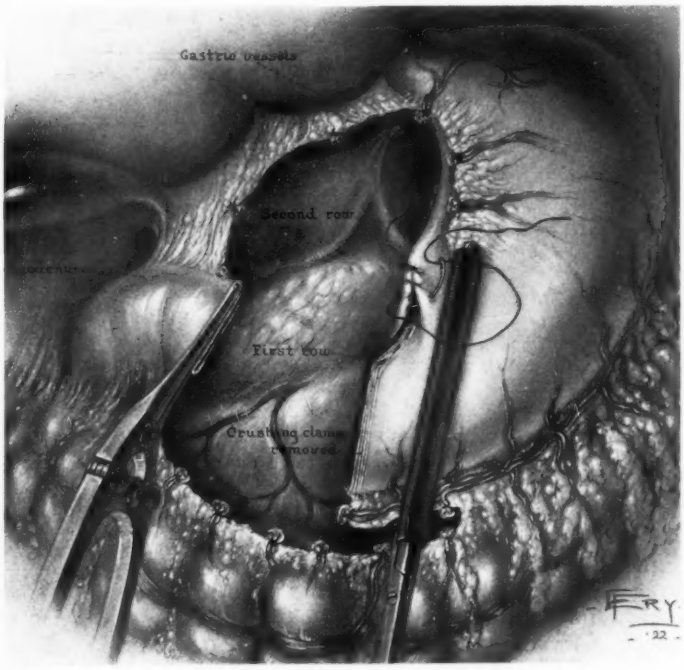

Fig. 2. Second stage of Billroth I operation for resection of the stomach.

resultant additional percentage of cures would be greater than the increased mortality would justify. If total gastrectomy is performed, I have found that the anastomosis of the jejunum to the œsophagus is best effected by the technique of Moynihan, beginning the union posteriorly by peritoneal-muscular sutures as the stomach is gradually cut free from the œsophagus. In this manner in a small number of cases I have been able to remove the stomach with less difficulty than might be expected. My own experience with complete gastrectomy has given me only one five-year cure. This patient is able to work and support his family, and by taking frequent meals is fairly well nourished, but he has a very peculiar pallor, at first glance appearing much like the pallor of pernicious anæmia. This peculiar type of anæmia has become apparent in our patients who have recovered from primary total gastrectomy. It is evident that the stomach has some immediate relation to the health of the red blood cell, and holds this property in common with the proximal end of the colon.

The Billroth II method of partial gastrectomy, closing both the end of the duodenum and the stomach, and performing a separate gastro-enterostomy has an established position in gastric surgery. As a method of partial gastrectomy subsequent to a gastro-enterostomy and in the two-stage operation in which the gastro-enterostomy is made at the first stage and removal of the diseased portion of the stomach at a second stage some days later, it is without competitor.

Balfour's modification of the Pólya operation in which the side of the jejunum is anastomosed to the amputated end of the stomach, antecolic, instead of retrocolic as in the Pólya, enables the removal of large portions of the stomach with comparative ease. This method is the one of choice and one might say, of necessity, for the average case in which the greater part of the stomach must be removed because of the size and situation

of the growth. In the Pólya type of partial resection, end-to-side, stomach-to-jejunum posteriorly, Charles H. Mayo some years ago introduced a method of removing a larger amount of the gastric wall on the lesser curvature, stitching the defect down to a bottle neck, applying the side of the jejunum to the narrowed end of the stomach. This procedure, so far as the treatment of the lesser curvature is concerned, is essentially the method here described.

The Billroth I operation is again coming to the front, not only for cancers located in the pyloric end of the stomach, but also for many ulcers of the lesser curvature. Instead of removing an unnecessarily large area of the stomach as in the older forms of partial gastrectomy, it removes the disease, saves the normal stomach, and restores the gastro-intestinal canal by uniting the duodenum to the amputated end of the stomach. As cancer has much the same area of distribution as ulcer, and it has been shown by a number of investigators that the lateral extension of cancer of the stomach is not more than 3 centimeters from the visible portion of the growth, this operation also has a useful function in cancer of the lesser curvature. Surgeons of this generation have been very largely influenced by the experience of the master surgeon Billroth, and the prejudices of his time have extended to the present so that the whole force of surgical experience has been to avoid the reunion of the gastric stump to the duodenum. It will be remembered that Péan, the great French surgical technician, who was the first to remove the pyloric end of the stomach for cancer (1879), made a direct union, and his patient died. Rydigier, in 1880, performed the second operation of this type; his patient also died. Rydigier's case was planned deliberately, and while it ended in failure he should be given full credit for his original conception. Péan's case was an accident, the result of an operation started for another purpose, and the resection was forced by events. Billroth, in his first successful case in 1881, removed the pyloric end of the stomach and united the stomach, end-to-end, with the divided duodenum. The operation was successful, but the end of the stomach being so much larger than the end of the duodenum, he found it necessary to narrow the stomach along the lesser curvature by a set of sutures which ran at right angles to the anastomosis and where the longitudinal and circular sutures met, leakage so often occurred that the site was given the name of "the fatal suture angle." To obviate this defect Kocher closed the end of the stomach and anastomosed the end of the duodenum to the posterior wall of the stomach, a method which could be applied only to the most favorable type of case.

Conditions have changed greatly since Billroth's time. Surgeons now suture in various directions in other portions of the gastro-intestinal tract, and with success, other things being equal. For many years in the Clinic, the Billroth I operation has been performed in suitable cases, both for cancer and for ulcer, and increasing experience is extending its use. In certain persons the shape, position, and movability of the stomach together with its loose attachments have made it comparatively easy to remove the pyloric half and still directly anastomose the end of the gastric stump to the duodenum. If the end of the gastric stump is not more than twice the size of the end of the duodenum, the difference in caliber can be stitched out by placing two stitches on the gastric side to one on the duodenal side; it is surprising how smooth such an anastomosis will appear when completed (Fig. 3). If the end of the amputated stomach is more than twice the diameter of the duodenum, it is narrowed by the proper placing of reducing sutures on the lesser curvature.

Schoemaker was the first to free himself entirely from the Billroth prejudice. He recognized fully that the fatal suture angle did not occur under modern technique, and showed that the extensive removal of the lesser curvature of the stomach with sufficient of the pyloric end to accomplish the purpose of the operation would, in a considerable percentage of cases, enable direct union between the cut end of the stomach and the duodenum. Schoemaker has invented some special instruments which he uses with great skill; his excellent work in this connection is

most stimulating and suggestive. Experience in the Clinic in similar, but less carefully thought out, procedures has led us to accept the Billroth I operation as a primary procedure to be used on ulcers and carcinomata which are situated on the lesser curvature and pyloric end of the stomach in such a manner as to permit the application of the method. The value of the procedure has been shown particularly in the last 2 years, since we have been able properly to mobilize the lesser curvature of the stomach. After the application of the Billroth I method, there is a tendency for the stomach to drop to the left of the spine, its weight exerting an injurious strain on the suture line uniting the end of the duodenum to the gastric stump. This difficulty has been overcome in these cases and also in cases in which, following excision of gastric ulcers or a Finney pyloroplasty, there is tension due to the dropping of the stomach as a whole to the left of the spine. A point on the anterior wall of the stomach sufficiently far to the left is chosen, the stomach is drawn to the right and attached to the suspensory ligament of the liver by several catgut sutures in a manner to bring the entire anastomosis to the right of the spine (Fig. 4). There has been no suture leakage and gastroduodenal drainage is greatly improved. As a temporary measure, the procedure is a useful technical manœuvre in many operations on the stomach, when the weight of the stomach lying far to the left pulls the duodenum rather tightly across and to the left of the spine, and perhaps may be useful in certain congenital conditions which interfere with gastric function not because of the presence of ptosis but because of interference with gastroduodenal drainage.

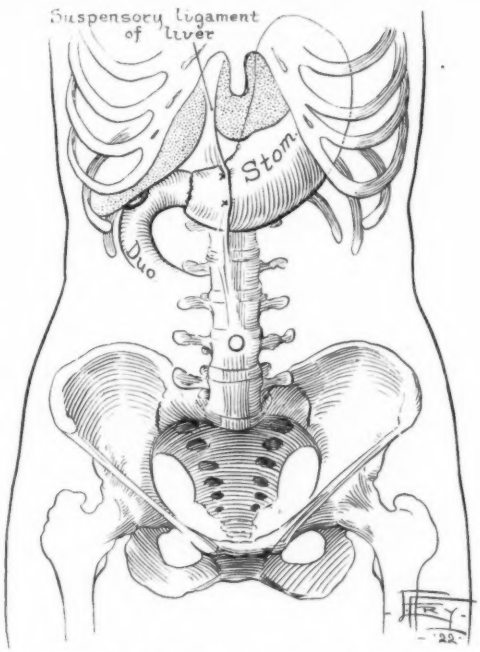

Fig. 4. Billroth I operation for resection of the stomach Gastroduodenal anastomosis drawn to the right side by two catgut sutures placed in the suspensory ligament of the liver and the stomach.

Proper mobilization of the lesser curvature of the stomach is the most important single step in radical operations on the stomach. The more favorable placing of incisions, the better mobilization of organs, and other technical manœuvres directly concerned with operations on the organs and viscera, not only in the abdomen but in the head and thorax, are increasing both the quality and the quantity of surgery by the reduction of mortality and the extension of operability.

THE SURGICAL TREATMENT OF ULCER OF THE STOMACH AND DUODENUM

By PROF. DR. HANS FINSTERER, Vienna, Austria

THE surgical treatment of ulcer of the stomach and duodenum may be said to be in a developmental state as far as the indications and the selection of the proper operative procedure are concerned. Those who favor the radical method blame gastro-enterostomy for their failures, while the adherents of the latter consider the radical method too dangerous and insist at the same time that a relapse cannot, with certainty, be prevented by this operation. I, myself, have for many years favored the radical method because I find it no more dangerous than gastro-enterostomy and because the end-results are far better. Gastro-enterostomy was the routine operation when I was assistant in the Hochenegg clinic. In my own experience in the last 7 years I have performed this only exceptionally, as, for instance, in the case of an acute perforation with peritonitis, or in certain cases of acute hæmorrhage in a duodenal ulcer. While up to 1914 I had performed 98 gastro-enterostomies and only 19 resections, the latter chiefly for suspected cancer, I have since performed only 40 gastro-enterostomies as against 427 resections.

An acute ulcer will heal spontaneously or by medicinal treatment and should be treated that way, the stomach ulcer as well as the duodenal. I operate upon the chronic ulcer when repeated medical treatment fails to cure it, when the recurring attacks with accompanying pain invalidate the patient. Individuals living at a great distance from a surgical clinic should be operated upon sooner than the people of a large city, because in case of perforation or of acute bleeding they cannot be transported without danger and without diminishing their chances of recovery. Early operation prevents perforation and acute hæmorrhage as well as the carcinomatous degeneration in ulcer of the stomach. I have never observed malignancy in a duodenal ulcer.

An acute perforation into the free abdominal cavity constitutes an absolute indication for operation. The success depends upon the interval which elapses between the perforation and the time of operating. Resection cannot be done in these cases except in the first few hours after perforation. Two such cases were operated upon successfully. Closure of the ulcer of the lesser curvature was performed four times; all 4 cases came late to operation, 34, 40 hours, and 7 days respectively. Of these, three died and one recovered. Of 19 cases of closure with an additional gastro-enterostomy 11 were cured and 8 died. All of these cases were operated upon from 12 to 24 hours after the perforation and exhibited signs of general peritonitis. One may do a successful operation as late as 24 hours after the perforation. Of 5 cases which came to operation 24 hours after, 4 recovered and only 1 died. The most essential elements of success in these apparently hopeless cases with diffuse peritonitis, cold extremities, and a small, thready pulse, are the use of local anæsthesia, cleansing of peritoneal cavity with normal salt solution and the after-treatment.

In acute hæmorrhage the early operation (24 to 48 hours after the hæmorrhage started) yields the best results. Among 20 early operations I had one death in five gastro-enterostomies. In 15, resection was the method and all of the cases recovered. Of 31 cases of late operations upon patients who were first treated medically from 4 to 14 days, and were sent to the operating table almost exsanguinated, we saved 22. The result in these cases depends upon the degree and the duration of anæmia with its consequent parenchymatous degeneration of the liver, the kidneys, and other organs. Great care must be exercised in giving morphine to these patients, both before and after the operation, as the ordinary doses may prove fatal. One must also be careful in the use of novocaine, substituting a one-fourth per cent solution for the usual one-half per cent. In gastric ulcer resection is possible even during hæmorrhage.

In the bleeding duodenal ulcer which cannot be resected, we ligate the pylorus, perform a posterior gastro-enterostomy and then press a large tampon upon the anterior duodenal wall and thus control the hæmorrhage by compression. This method, however, is applicable only in duodenal ulcers. Uncomplicated gastric ulcers, even those high up in the neighborhood of the cardia, can always be resected. Resection of a duodenal ulcer becomes impossible if the region of the papilla is involved.

Stomach resection has become a typical procedure with us and does not offer any difficulty except in certain cases of indurated ulcers. We begin with a hypodermic of morphine and then follow with local novocaine anæsthesia of the abdominal wall and the peritoneum. With this technique, the use of broad retractors is quite painless. We expose the space between the liver and the stomach and insert the needle above the cœliac trunk over the guiding finger with which we attempt to separate aorta and vena cava. We then inject upon the soft tissues overlying the twelfth vertebra, slightly to left, 50 to 70 cubic centimeters of a 0.5 per cent novocaine solution. This anæsthesia permits of a good deal of traction, so that even an indurated ulcer may be removed without pain. When, as the result of adhesions, the aorta and vena cava cannot be separated, splanchnic anæsthesia must be abandoned and the injection of the lesser omentum along the course of the two gastric arteries as well as of the base of the mesocolon along the right and the left gastro-epiploic arteries must be substituted.

The stomach and the duodenum are now carefully examined for the seat of the ulcer, if necessary with the finger in the stomach. Adhesions to the gall bladder are separated and in the case of stones or infection, cholecystectomy is performed. If we find an ulcer on the anterior wall of the duodenum, we must carefully examine the duodenum and the pancreas for the existence of another ulcer on the posterior wall. These not infrequently penetrate into the pancreas itself. We orient ourselves as to the extent of the ulceration, even if it be necessary to mobilize the duodenum by incising the peritoneum laterally until the region of the papilla is exposed. The choledochus must be followed from the junction with the cystic duct to the papilla to make sure that it can be isolated from the ulcer.

The technique of the resection is as follows: We find the first portion of the jejunum through a slit in the mesocolon which is made in a radial direction from the base to the arcade nearer the left side. Through this slit we draw up the first part of the jejunum. Next we separate the duodenum from the pancreas. In the case of a penetrating ulcer, the borders are separated and the base of the ulcer is left behind. We ligate the duodenum, invert the ligated part, and cover it with the remnants of the hepatoduodenal and the hepatocolic ligaments. The line of resection does not run vertically to the stomach but parallel to the median line of the body. The upper part of the resected stomach is closed by three rows of suture, the lower is temporarily clamped. We now suture the left side of the split mesocolon between jejunum and stomach about 10 centimeters long, the afferent part of the jejunum running toward the upper part, the efferent on the large curvature, the anastomosis itself lying in the median line. The aperture in the split mesocolon is sutured to the stomach. In this manner the anastomosis lies below the mesocolon. In an ulcer penetrating the pancreas, and the bed of which has to be left behind, we have to use drainage if the area cannot be peritonealized.

In gastric ulcer the resection of the duodenum is much easier, while in cardiac ulcers it may be very difficult. If the ulceration extends into the œsophagus, the resection should not be performed, because a fistula is certain to occur. I have performed the square median resection of the stomach nine times but have abandoned it in the last 8 years because the hyperacidity remained unaltered. I prefer to resect the pylorus and the antrum in gastric ulcers. The leaving behind of an ulcerated pancreas is without an consequence, but drainage becomes necessary. However, through this leaving of the base of the ulcer, even the largest and most extensive ones can be resected. Insufficiency of the stump of the duodenum was never observed. In an ulcer of the duodenum which cannot be removed on account of anatomical difficulties, I no longer

perform a gastro-enterostomy or an unilateral exclusion after Eiselsberg. The latter procedure, while permitting the healing of the ulcer, carries with it the danger of formation of peptic ulcer of the jejunum (Haberer had 25 per cent peptic ulcers with this method).

My method is to resect a large portion of the stomach. I recommended the method in 1918 in the *Zentralblatt fuer Chirurgie*, as a result of my observations at that time and applied it in all cases where the resection of the ulcer was technically impossible. The technique is as follows: The stomach is resected 2 to 3 fingers' width beyond the pylorus, the peripheral end is closed by a double row of sutures and covered by the remnants of the gastrocolic ligament. Of the stomach two-thirds or three-fourths (15 centimeters of the small, 25 centimeters of the large curvature) is resected, the cut is placed obliquely to the axis of the stomach, and a typical end-to-side anastomosis is performed. If the ulcer does not reach the pylorus, one may remove the pylorus, cut the duodenum close to it and suture it. The typical removal of the pylorus for the sake of exclusion is dangerous for the safety of the closure of the duodenum. I have formerly performed a gastrectomy up to the anastomosis in cases where a previous gastro-enterostomy had been done but where, on account of persistent symptoms, another operation was indicated. The results, however, were poor. I now resect the anastomosis and make a new side-to-end anastomosis higher up.

The technique of the anastomosis is that which Hofmeister described and which is known as Billroth II. Billroth I, the direct union of stomach and duodenum which Haberer calls the ideal method, I performed in gastric ulcers where it was easy to do so, but very seldom have I done it in duodenal ulcers. The end-results, however, were much poorer than with the ordinary Billroth II. I observed two positive relapses among 52 cases. The great discomfort present was evidently due to new adhesions of the duodenum.

The mortality in resections is not larger than after gastro-enterostomy in most clinics. Not including the cases of acute hæmorrhage, in which the result depends upon the amount of blood lost, I have now in 407 cases a mortality of 4.4 per cent, of which the greater portion was due to insufficient asepsis. Since 1919 I have operated upon 296 cases with a mortality of 2.3 per cent. In these I include 207 cases of particularly difficult resections (more than half of the stomach) with only 3.3 per cent mortality. In the last three and a half years I had, among 158 resections, only three deaths: one postoperative hæmorrhage in a case of liver cirrhosis; one hæmophilia and one peritonitis, which means a mortality of 1.8 per cent. I wish particularly to emphasize that no case died within the first few days of so-called shock or heart failure. Not a single case died of pneumonia, although I resected in every case when technically possible regardless of cachexia or lung complications such as emphysema, purulent bronchitis, or tuberculosis with cavities. I would emphasize particularly that 43 patients were between the ages of 66 and 76 years, and in spite of lung complications, all recovered and are still well.

These really splendid results I ascribe, first of all, to the use of novocaine in the place of general anæsthesia. Whenever surgeons say that local anæsthesia in ulcer is impossible it is more likely that the method has not been used properly. Formerly I injected only into the lesser omentum and into the base of the mesocolon and into the parietal peritoneum of the pancreas. With this method I was able to operate upon two-thirds of the cancer cases, 40 per cent of ulcer cases without a drop of ether, 36 per cent of cases in which 20 to 50 cubic centimeters of ether were given in 2 hours, so that one cannot call this an ether anæsthesia. Only in 24 per cent of the cases was ether given for some time.

With the splanchnic anæsthesia, which I used in 232 cases without a complication, I was able to operate upon 89 per cent of the cases without ether. In the rest of the cases a slight ether rausch was used, but as a rule the operation could be completed without it. Only in 2.1 per cent of the cases did the local anæsthesia fail. In these cases extensive adhesions in the retroperitoneal space prevented the diffusion of novocaine. The splanchnic anæsthesia, therefore, is the greatest advance in the surgery of the painful penetrating ulcer. My experience completely disproves

Gottstein's contention that lung complications cannot be prevented by local anæsthesia. The retention pneumonia can be prevented through an exact after-treatment, pulmonary exercises, and the coughing up of secretions at regular intervals. However, should pneumonia set in, the prognosis is much better because the heart has not been vitiated by an anæsthetic. While in other clinics pneumonias occurred after gastro-enterostomies upon selected cases, I have not lost a single case from pneumonia in my massive resections of the stomach. The end-results are good provided enough of the stomach has been removed. I have not had a peptic ulcer of the jejunum among my cases. Not all of the gastric cases were followed up; however, I am not aware of a single failure. The duodenal ulcers were carefully followed up so that at the present, after 2 years, I have 94 per cent of absolute cures. Only 6 per cent had slight discomfort and this was caused by ventral hernia, cholelithiasis, etc. Peptic ulcers or very severe symptoms were not observed.

The results are likewise favorable in the gastric resections for the purpose of exclusion in an inoperable ulcer; at any rate they are better than after gastro-enterostomy (Payr 62 per cent, Haberer 36 per cent good results). Ninety per cent of my cases are free from symptoms. Eight per cent have slight symptoms which are mainly referable to cholelithiasis, adhesions, etc. In one case only did I see a relapse. A large peptic jejunal ulcer developed which required a second operation. I had not removed enough stomach and a retrograde filling of the duodenum developed, and through this a hyperacidity which had to be combated by alkalies. In resection it is absolutely essential to remove two-thirds to three-fourths of the stomach, and through exact incision and anastomosis prevent retrograde filling of the stomach stumps.

In the gastro-enterostomy of the posterior type with a short loop, I have a mortality of 11.8 per cent in 144 cases. Excluding the cases operated upon for acute hæmorrhage, there remain 113 cases with 4.4 per cent mortality. The causes of death were: erosin in one; perforation, one; peritonitis, one; two cases of inanition. There was no pneumonia and the end-results did not differ from those of other clinics. They were, however, much poorer than those of resection.

Among 37 cases of gastro-enterostomy for duodenal ulcer, there were two cases of peptic jejunal ulcer. The rest of the patients must be careful in their diet to stay free from symptoms. The radical operation for peptic jejunal ulcer is one of the most difficult. This operation can likewise be performed under splanchnic anæsthesia. It consists in the resection of the duodenum and of a large portion of the stomach, including the anastomosis, followed by a new union of the jejunum and stomach. I did 12 such operations with splanchnic anæsthesia alone, in 9 cases ether had to be supplemented, in 9 cases mesenteric anæsthesia and ether were necessary. One case had a diffuse peritonitis, the result of perforation into the free peritoneal cavity, and one case was bloodless after erosin of the median colic artery. Both cases died. In the resections upon 28 uncomplicated cases, 27 recovered and only 1 case died. In this case the ulcer developing in the anastomosis penetrated deeply into the pancreas and was spread over the whole posterior wall. It was really inoperable because the stomach could hardly be closed. This formidable operation has lost a great deal of its danger through the use of local anæsthesia. However, to obtain satisfactory end-results, a great deal of the stomach must be removed; removal of pylorus and antrum as recommended by Schur and Lorenz is not sufficient.

I removed the pylorus and antrum and made a Y anastomosis in two brothers who suffered from peptic jejunal ulcer, after a gastro-enterostomy for hæmorrhages and pain. The symptoms persisted notwithstanding the use of alkalies and atropin. A year and a half ago a third operation was performed because of the severity of symptoms, and at this operation a large pancreas ulceration in the Y anastomosis was revealed. I resected the anastomosis and a large portion of the stomach, and since that time both are perfectly well and can eat everything. These two cases demonstrate in a striking manner the advantages of massive stomach resection.

MORTALITY IN SURGERY OF EXOPHTHALMIC GOITER

By JOHN DE J. PEMBERTON, M.D., F.A.C.S., Rochester, Minnesota
Section on Surgery, Mayo Clinic

THE results of the present-day surgical management of exophthalmic goiter compare favorably with those of any surgical procedure of equal magnitude. In the Mayo Clinic during the year 1922, 1,093 operations were performed for exophthalmic goiter with 11 deaths, a mortality of 1 per cent. These figures were computed from the surgical procedures on patients with exophthalmic goiter only, the diagnosis of which was based on the clinical history and findings and on the basal metabolic rate, and corroborated in every instance in which gland tissue was removed by the pathologist's diagnosis of diffuse parenchymatous hypertrophy of the thyroid gland. Unless the clinical diagnosis is accurately checked by the estimation of the basal metabolic rate and by the characteristic pathological findings in the gland a large loophole for error exists. A definite distinction must be made between exophthalmic goiter and other types of goiter if the facts are to be reached. If statistics are based on the various surgical procedures for goiter, only a vague idea can be obtained of the operative risk of patients with exophthalmic goiter, for the mortality rate will be diluted in direct ratio with the number of simple goiters included in the computation. Thus during the same period there were 663 thyroidectomies on 663 patients for adenomatous goiter without hyperthyroidism, with one death; a mortality rate of 0.15 per cent.

In the earlier days of thyroid surgery the relatively high mortality rate was an influential factor in the decision of many patients with exophthalmic goiter to seek means of cure other than surgery. Many of these finally came to surgery late in the course of the disease, when the operative risk was increased and when the prospect for complete cure was greatly diminished; thus a small vicious circle was created. But the knowledge of the benefits derived from surgery has gradually become more widely disseminated, and today a much larger proportion of patients with exophthalmic goiter seek surgery primarily, early in the course of the disease, when the risk is less and the prospect for complete cure is greatest.

The causes of death following operation on patients with exophthalmic goiter may be conveniently divided into three groups: (1) death as a direct result of the disease or the effects of the disease; (2) death as a direct result of an accident, and (3) death as the joint result of the disease and an accident.

GROUP 1

The rôle played by the disease itself as the direct cause of death following operation may be considered under two headings, acute exacerbation of hyperthyroidism or dysthyroidism induced by a normal operative procedure, and visceral degenerative changes incident to the long-continued hyperthyroidism.

Acute exacerbation of hyperthyroidism may be induced by the effects of the surgical procedure, by an intercurrent disease, trauma or shock, or it may be spontaneous at any time during the course of the disease.

The spontaneous crises of hyperthyroidism are sometimes observed while the patient is under treatment. One of the 11 deaths credited to surgery in the series of 1,093 operations performed at the Mayo Clinic in the year 1922, belongs in this group. A middle-aged woman (Case A399664), with moderately severe thyroid toxæmia, and a basal metabolic rate of +69, convalesced normally for 4 days following ligation of the left superior thyroid vessels. On the third and fourth days after ligation, her general condition was good and she was out of bed. It was noted, however, that she was more depressed than usual. On the fifth day her appetite was poor and she complained of pain in the upper abdomen. By the tenth day she was in a typical crisis of exophthalmic goiter, with much abdominal discomfort accompanied by nausea and vomiting. She became irrational on the twelfth day

and died on the fourteenth day after operation, from acute hyperthyroid crisis with high fever. Necropsy revealed a healed left cervical incision; hyperplasia and adenomata of the thyroid; persistent thymus (25 grams.): cardiac hypertrophy (475 grams.) and dilatation 2+ with fatty changes; pulmonary œdema and congestion; beginning arteriosclerosis of the kidneys with hypertrophy, and fatty changes in the liver.

Our means of combating the postoperative reaction of dysthyroidism, when once induced, are ineffectual, but within recent years many advances in preventive measures have been made. The occurrence of reactions, although thus greatly reduced in number and severity, must still be considered as only partially avoidable. The preventive measures divide themselves into the pre-operative preparation of the patients and the details of the surgical management. By means of preliminary treatment through the co-operative efforts of the internist, the laboratory and the surgeon, the condition of the patient in most instances can be so greatly improved that the danger of postoperative thyroid crisis is reduced to a minimum.

Between 30 and 40 per cent of the patients with exophthalmic goiter are in good condition on admission to the Clinic, and require only routine preliminary examination and treatment to prepare them for thyroidectomy. The condition of one-half of the remaining 60 to 70 per cent, who are not considered safe for operation on admission, can be so markedly improved in 10 to 14 days under medical management, consisting of rest, adequate diet and fluids, digitalis as required, and the judicious administration of iodides (Lugol's solution), that the patients become safe risks for primary thyroidectomy. For the remaining 30 to 40 per cent, preliminary surgical measures, such as ligations and injections, are necessary: (1) when there is doubt as to the possibility of an acute reaction in a moderately toxic patient following a major operation, a ligation is performed or an injection of boiling water is given as a tolerance test, and (2) when it is apparent that a primary thyroidectomy is almost certain to induce an acute reaction in a more toxic patient, the minor operative procedures are employed as therapeutic measures. Later, after a period of rest, in most instances the benefits derived therefrom are so marked, that the operation for the resection of the goiter can be undertaken with almost complete assurance of the absence of any postoperative reaction.

The residual effects on the organism of long-continued hyperthyroidism manifest themselves in visceral degenerative changes, especially affecting the heart, liver, kidney and muscles. These changes are often insidious in onset, but slowly progressive and, unfortunately, only partially remediable. As is to be expected, patients in this group form the largest part of the mortality list in the surgery of exophthalmic goiter. However, the added risk in this group is a justifiable one, and must be faced, for successful surgery restores to nearly complete health many of these otherwise hopeless invalids. While the relative proportion of patients with visceral changes admitted to the Clinic is still too large, fortunately this proportion is diminishing year by year, owing to the fact that the patient with exophthalmic goiter is coming to operation earlier in the course of the disease. Preparatory measures similar to those I have outlined are indicated, and sometimes much benefit can be derived. In many other instances little improvement can be gained short of the partial removal of the gland. In some instances the degenerative changes are so advanced that the patients will die while under treatment, before they can be prepared for thyroidectomy. In the series reported here, one patient, whose death is credited to surgery, may be included in this group:

CASE (A398524), a woman, aged 38, was admitted to the Clinic July 19, 1922, with symptoms of intense hyperthyroidism of 5 months' duration. She was extremely emaciated, her weight having dropped from 122 to 94 pounds. There was cardiac decompensation with marked œdema of the legs and marked pulsation of the veins of the neck. The systolic blood pressure was 208, the diastolic 132. There were punctate, papulopustular lesions on the back, and the Wassermann reaction was strongly positive. The basal metabolic rate was +102. The pulse rate was 142 and thready in character. Dyspnœa and cyanosis were moderate. There were

occasional spells of vomiting. The patient was placed in bed and given digitalis. Her condition improved slightly and August 22, 2 cubic centimeters of boiling water was injected into the right lobe of the thyroid. No reaction followed, and August 29, 3 cubic centimeters of hot water was injected without incident. August 31 and September 5, division and ligation of the left and right superior thyroid vessels, respectively, was made, without any reaction. Her general condition at this time was considerably improved, her appetite was good, and she was able to sleep well at night. Her improvement continued until September 9, when respiration gradually increased in rate and it was noted that the abdomen was distending. The liver was enlarged to 10 centimeters below the costal margin. Œdema of the feet, ankles, and gluteal region was markedly progressive. September 11, there was evidence of fluid in the chest, and September 12, the right chest was aspirated with the removal of 900 cubic centimeters of clear, straw-colored fluid. Following this, there was some improvement in respiration, but slight jaundice developed and the patient complained of abdominal cramps which were accompanied by a slight diarrhœa. September 15, the fluid reaccumulated. The patient grew progressively worse and died September 24. Necropsy revealed exophthalmic goiter, acute hæmorrhagic glomerulonephritis, multiple, small, infected pulmonary infarcts, hypertrophy of the heart (375 grams.) and dilatation of the left ventricle.

GROUP 2

The accidents responsible for death following operation on the thyroid gland are similar to the accidents following other operations. They may be divided into those avoidable and unavoidable.

Haemorrhage. In the early surgery of goiter, hæmorrhage on the operating table was common, and often fatal. Today, while profuse hæmorrhage is sometimes encountered during the course of thyroidectomy for a very vascular and friable goiter, our means of controlling bleeding are so vastly improved, that this is practically never a direct cause of death. However, if excessive bleeding has occurred during the course of an operation in a bad risk case, it may prove a contributing factor in the cause of death. Owing to the vascularity of the thyroid and to the fact that the stump of the resected gland is movable on swallowing and coughing, postoperative hæmorrhage is not uncommon, but as its presence is usually manifested early by the development of pressure symptoms and a tumor in the neck, it can readily be detected and controlled before the loss of blood volume is sufficient to be alarming. Therefore, unless the surgeon is careless in recognizing the danger signals, or unless the bleeding is within the mediastinum, this complication is practically never the direct cause of death.

Obstructive dyspnœa. This complication in goiter surgery must be constantly borne in mind by the operator. It is always of serious importance, not infrequently is a contributing factor, and at times is the decisive factor in the death of the patient. Conservatively estimated, I believe that 90 per cent of all such deaths are avoidable, an opinion opposed to that formerly held, when the cause of practically all postoperative obstructive dyspnœa was credited to collapse of the trachea or to œdema of the glottis, apparently unavoidable complications. Instances of collapse of the trachea with serious dyspnœa, have been encountered during and after the removal of large goiters, but they are very uncommon. Similarly, it is rare to find postoperative œdema of the glottis of sufficient degree to produce serious dyspnœa. The most common cause of this very serious complication is paralysis of one or both of the vocal cords, as a result of either permanent or temporary injury of the recurrent laryngeal nerve. Other causes may be enumerated, such as partial occlusion of the trachea from pressure of forceps, or from substernal or retrotracheal adenoma, postoperative hæmorrhage and infection, and surgical rotation of the trachea.

Tetany. Theoretically, parathyroid tetany must always be included in the list of dangers associated with operations on the thyroid gland; but, practically, with the standardized operations of today, its incidence is so small and the severity of the attack is so mild, that its rôle can be considered only with those complications of lesser importance. In my experience this accident most often follows operation for recurrent goiter, when the second operation consists in a too liberal resection of the remaining lobe.

From 1917 to 1922, inclusive, there were in the Mayo Clinic more than 10,000 operations for the resections of the thyroid gland, and the records show the occurrence of symptoms

suggesting tetany in 35 cases. In 11 of these cases the symptoms consisted only of a transient sensation of slight numbness, or a painful twitching of the fingers and toes, and a reasonable doubt of the diagnosis existed at the time. In the other 24 cases, while the symptoms were more definite, with painful contractions or spasms, the tetany was of a transient nature and easily controlled by the administration of calcium. In no instance in this entire series has tetany been an associated complication in the operative mortality.

Pulmonary infection. This complication in patients with exophthalmic goiter is relatively common and is often an important, if not a decisive, factor in the death of the patient. Its occurrence is readily accounted for by the weakened and debilitated condition of the patient, a result of the disease. At necropsy pulmonary infection is noted in from 20 to 30 per cent of patients with exophthalmic goiter, but in many of these its presence can be explained as a terminal process. The complication cannot be strictly considered as avoidable, but its incidence can be materially reduced by care in the surgical procedures. The avoidance of prolonged general anæsthesia, of prolonged surgical trauma, and of injury to the recurrent laryngeal nerve is in this connection a principle of paramount importance.

Air embolism. While the number of deaths proved to be due to air embolism is very small, I am convinced that it is a danger in operations for goiter which every surgeon should fully appreciate. During the course of an operation for the removal of a goiter, when an unrecognized opening in a large vein has resulted from tearing or from the loosening of a clamp or ligature, conditions are ideal for the entrance of sufficient air into the circulation to produce death. On two occasions during the process of thyroidectomy for large goiters I have seen the sudden development of alarming symptoms of cyanosis, dyspnœa, loss of consciousness, and rapid, weak pulse follow the unrecognized loosening of a ligature around a large vein. In both instances the symptoms disappeared shortly after the immediate occlusion of the opening in the vessel. If facts were known, I believe that this complication would account for many of the "unexplained" goiter deaths that have occurred on the operating table, or a few hours later. To avoid this, the thyroid veins should be tied as they are divided, and at the conclusion of the operation before the wound is closed, the patient should be made to strain, as by coughing, in order to detect the presence of an insecurely tied vein.

Pulmonary embolism. The occlusion of a large branch of the pulmonary artery by a blood clot is an unavoidable tragedy which occurs in association with all major surgical operations, but fortunately, in operations for goiter its occurrence is uncommon. Thus, Heard, in reviewing the cases of pulmonary embolism in the Clinic, found that from 1912 to 1920 inclusive, there were 14,911 operations for resection of the thyroid, and 3 deaths from pulmonary embolism, or 1 in 4,970. During the same period there were 4,145 ligations with 1 case of pulmonary embolism.

Infections. Wound infections occur with about the same frequency as in other surgical cases of similar nature, and, fortunately, only in the exceptional case does it endanger the life of the patient. When a tracheotomy has been necessary after the removal of a large substernal or intrathoracic goiter, the consequent infection may invade the mediastinal structures and prove fatal.

Intercurrent diseases. Diabetes, influenza, erysipelas, thrombosis, and so forth, may be encountered, and their influence on the result of the operation will vary with the severity of the disease.

GROUP 3

Often death following operation may be caused by the disease and some exciting or contributing factor, other than the effects of a normal operative procedure. For instance, a patient with moderate toxæmia, who in all probability would survive an uncomplicated operation, may die if the operation or the convalescence is complicated by an accident, such as obstructive dyspnœa, hæmorrhage, or pneumonia, which in itself is not of sufficient magnitude to prove fatal. A postoperative accident may occur in the non-hyperthyroid patient and prove of only minor significance in the convalescence, whereas a similar com-

plication in the patient with exophthalmic goiter may be the decisive factor in the death of the patient. In cases of exophthalmic goiter the margin of safety is so small that any added tax on the organism may completely alter the operative result. Extreme care of details in the surgical management of patients with exophthalmic goiter is paramount.

MORTALITY

During the year from January 1, 1922, to December 31, 1922, 1,093 operations were performed on 633 patients with exophthalmic goiter. Eleven patients died, a mortality by case of 1.73 per cent, and by operation of 1.005 per cent.

	Cases	Mortality	Per cent
Thyroidectomies for exophthalmic goiter[1]	523	5	0.93
Ligations preliminary to thyroidectomy for exophthalmic goiter	485	4	0.82
Hot water injections preliminary to thyroidectomy for exophthalmic goiter	82	1	1.21
Injections 0.5 novocaine preliminary to thyroidectomy for exophthalmic goiter	3	1	33.33

This includes all patients with exophthalmic goiter who died in the hospital following surgical procedures without regard to length of time or cause of death. None of the patients was transferred after operation to "medical service." As shown in the tabulation, 2 of the 11 patients who died had injections only. In the Clinic this procedure is used as a tolerance test if patients are desperately ill, and it is probable that one or both of these would have died as a result of the disease, irrespective of the injection. Two other patients, whose records are abstracted herein, died as a result of the disease. One man aged 68 years, with marked arteriosclerosis, died 9 days after ligation from thrombosis of the left femoral artery, with beginning gangrene of the foot. One patient died 50 days after thyroidectomy, as a result of an abscess in the spleen. One death 8 days after thyroidectomy was due to bilateral lobar pneumonia. One patient died 21 days after thyroidectomy, from bilateral bronchiectasis and multiple abscesses of the lung. The cause of death of the remaining 3 patients was hyperthyroidism and bronchopneumonia.

[1] The thyroidectomies were complete operations in one stage, except in two instances, in which the technical difficulties made it advisable to divide the operation into two stages.

SUMMARY

The mortality rate following surgical procedures in patients with exophthalmic goiter has been reduced to 1.005 per cent in terms of operation and 1.73 per cent in terms of patients.

The estimation of the basal metabolic rate and the characteristic pathological findings of diffuse parenchymatous hypertrophy of the thyroid gland are essential checks on the clinical diagnosis of exophthalmic goiter.

Statistics based on goiter operations do not give a correct idea of the operative risk of patients with exophthalmic goiter, for the mortality rate will be diluted in direct ratio to the number of simple goiters (without hyperthyroidism) included in the computation.

In computing the mortality rate, all deaths which occur in the hospital without regard to the cause of death or the length of time after operation should be credited to surgery.

The danger of reactions following surgical procedures can be reduced to a minimum by preliminary treatment and painstaking care in the management.

The patients with visceral degenerative changes form the largest part of the mortality list in surgery of exophthalmic goiter. The operative risk is less and the benefits derived are greatest when the patient comes to surgery early in the course of the disease before degenerative changes have occurred.

The avoidance of operative and postoperative complications by painstaking care of details in the management of surgical cases is essential to a low mortality rate in cases of exophthalmic goiter.

THE OPERATIVE TREATMENT OF EMBOLISM OF THE LARGE ARTERIES

A Report of Two Cases

By LEO BUERGER, M.D., F.A.C.S., New York

THE early removal of an occlusive clot from the larger arteries of the extremities, such as the brachial, femoral, or popliteal, gives promise of being an effectual mode of coping with impending gangrene of embolic nature. Unfortunately, the practitioner is not aware of the value of immediate surgical intervention in such cases, and the re-establishment of the circulation is hoped for through the mere institution of conservative methods. The condition should be recognized at the very onset of the arterial blockage, and arteriotomy with removal of the clot should be advised.

It is neither difficult from the diagnostic nor from the therapeutic standpoint to accomplish the localization of the embolus in the case of the upper extremities. Because of the accessibility of the brachial and axillary arteries to the touch, and the deductions that perceptible or imperceptible radial and ulnar pulsations can afford, the recognition of the site of the lesion is easy.

In the case of the lower extremities exact localization may offer a somewhat more intricate problem, but the extent of the coldness of the extremities, its upper limit, and the condition of the dorsalis pedis, posterior tibial, popliteal, femoral, and external iliac pulsations may permit us to restrict the possible territory in which the clot may lie to within a very short distance.

The following instance of the successful removal of an embolus from the brachial artery may be worthy of brief description, for it may be thereby demonstrated that the removal of an embolus about 5 to 6 hours after its lodgment in the brachial artery may be followed by complete restoration of the circulation through the normal vascular paths.

L. G., age 57, was said to have chronic endocarditis with mitral murmur, there having been a previous history of a number of attacks of erysipelas. About September 14, 1922, he was suddenly seized with a cramp in the right leg, lost consciousness temporarily, but recovered without medical assistance. The right leg became cold, blanched, and gradually darker and darker, developing dry gangrene.

The patient was seen by the author on September 20, at which time dry gangrene involving the greater part of the foot, and moist gangrene over the upper part of the leg had already developed, the lower third of the thigh also being cold to the touch. None of the pulses from the femoral downward was palpable.

Diagnosis: embolic gangrene.

September 21, 8:35 a.m., a typical circular amputation (without tourniquet) was done by the author through the upper fourth of the right thigh, the femoral artery being found filled with recent clot. At 2:45 p.m. of the same day the nurse was unable to obtain a pulse in the *right arm;* she noticed that the fingers were very cold, the hand pale, and that the patient complained of numbness and weakness in the corresponding hand and forearm. This condition was also observed several hours later by physicians, who recognized the embolic nature of the arrest of circulation in the right upper extremity, but the matter was not reported to the author.

The patient was seen by the author at 7:15 p.m. of the same day, and the following status noted: the general condition of the patient was fairly good; the right hand and forearm were cold and pale; neither the radial nor the ulnar pulsation was perceptible. On palpation along the course of the brachial and axillary arteries the pulse was found absent below the lower margin of the teres major muscle. The diagnosis of *embolism in the upper brachial artery* was made, and the operation of *arteriotomy* was immediately advised.

After consent was obtained, operation was performed at 9:06 p.m. of the same day.

Operation. The skin over the lower axillary and the upper part of the brachial arteries was infiltrated with 1 per cent novocaine solution, and about 2¼ inches of the course of the brachial artery exposed in the typical fashion, and the point of obstruction located. At about the level of the origin of the superior profunda artery a clot could be distinctly felt in the artery, pulsation below this point being absent, and the arterial girth considerably less than that of the vessel above, or at the site of the occlusion.

A Crile artery compressor and one serrefine were applied above and below, and a small incision about ¼ inch in length made longitudinally, immediately over the clot. Just as a compressing and milking movement was attempted in order to force the clot out of the opening, and as a portion of it protruded through the gap, the whole embolus was suddenly projected outward, evidently by virtue of a circulatory force within the artery itself. In spite of the presence of the clamps, bleeding was continuous, copious, and non-pulsatile, so that more intensive compression both above and below was applied. As the slit was opened with two delicate forceps, the bleeding which continued in spite of change to the above measures, caused the sudden evacuation of a small shred-like clot, evidently a tail-piece or accretion clot, that had blocked either the superior profunda or was riding upon the embolus in the brachial.

In view of the uncontrollable bleeding through the artificial orifice, it seemed evident that the artery had been opened just opposite to the point of origin of the superior profunda artery, through which a collateral reflux was going on.

It was decided, in view of the importance of the superior profunda as an anastomotic channel, to attempt closure and suture of the artery without tying off this vessel. After thoroughly lubricating the vessel with sterile albolene, the longitudinal aperture was compressed and closed with the thumb and index finger of the left hand. Then arterial suture was begun from above downward, with the finest silk (doubled) and the finest and smallest Kirby needles (Carrel pattern). Running suture was easily applied, the assistant pulling taut, tying the first knot, the last knot being tied by the operator. After the removal of the clamp not a drop of blood oozed out of the suture line, and it was not deemed wise to reinforce this.

Pulsation and dilatation of the brachial artery below were immediately restored, and the pulsations were confirmed to exist in the corresponding radial and ulnar arteries by an assistant.

Inspection of the fingers and hand immediately after the wound was closed demonstrated a return of color and warmth to the hand and forearm, and restored motility. The patient also noticed a prickling sensation throughout the fingers and hand.

Although the incision in the arm healed by primary union and the pulses were restored and remained so, the patient succumbed subsequently to the lodgment of multiple emboli, one in the left external or common iliac artery, and another possibly in a vessel of the right half of the cerebrum.

On September 28, 8 a.m., the left leg suddenly became cold and blanched, the femoral and the popliteal pulses being imperceptible. From then on the usual manifestations of early gangrene developed, the cyanotic discoloration of the foot and leg, and the coldness which extended up to the groin.

Although the patient was seen about one hour after lodgment of embolus in iliac artery and operation for it was advised, consent was withheld.

September 29, the patient was distinctly weaker, pulse more irregular, and he was at times irrational.

September 30, sudden left-sided palsy, cerebral disturbances, exitus. Up to the time of death the right radial pulse remained as strong as the left and the circulation of both arms equally good.

In short, this is a case in which embolectomy with removal of a large clot from the right brachial artery was successfully performed, with restoration of the circulation, until death which occurred 9 days after the operation.

Another case is instructive even though the patency of arterial channels situated at some distance from the site of the removed embolus could not be restored.

In a young man operated upon for gangrenous appendicitis by a colleague,[1] February 14, 1920, the right forearm suddenly became cold, cyanotic, and motionless early in the morning of the third day after the operation. The brachial artery did not pulsate below its upper fifth. The diagnosis of embolism was made.

February 17, some 3½ hours after the onset of the symptoms, the author exposed the upper portion of the brachial artery at the site of the thrombus, under novocaine anæsthesia, and by arteriotomy removed a clot about 2 centimeters in length, closing the artery by suture according to the Carrel technique. There was excellent pulsation in the brachial below the site of the clot, and no leakage after completion of the suture. In spite of this demonstrable patency of the brachial artery below the site of the embolus and thrombus, *no pulsation* could be detected in the radial artery. It was, therefore, believed that secondary clots had previously become detached and lodged in the peripheral vessels, or had grown upon the embolus (stagnation clots).

February 18, in spite of the re-establishment of the circulation in the lower brachial artery, the right hand was somewhat cold, but there was definite evidence of *marked improvement in its circulation*. On February 19 the color of the thumb looked doubtful, being somewhat cyanotic and cold. Furthermore, there were signs of muscular palsy and some tendency to contracture of the fingers in the flexed position. Extension of the hand seemed impossible, although motion of the fingers was excellent.

On February 20, after the application of dry heat in an electric baking apparatus in which a contact burn could have taken place, *trophic disturbances* became manifest over the posterior surface of the forearm. A long whitish area suggesting dead skin with loss of sensation over at least 3 inches by 1.5 inches appeared. There was another similar smaller area over the posterior aspect of the wrist and the skin just above. Later in the day, the central portions of these areas showed blebs.

[1] Dr. P. Aschner.

On February 25 the fact that a certain amount of gangrene would develop was well established, since the following lesions could be demonstrated; first, the trophic lesions; second, evidences of gangrene; third, circulatory disturbances.

The trophic lesions: The areas of circulatory insufficiency were well demarcated on February 25, there being an elongated area some 3 inches by 1.5 inches, surrounded by a well-defined, narrow line of deep red, as if a red chalk mark had been drawn around it. Within this there was a distinctly white zone less than 1 centimeter in diameter enclosing a central, purplish space, in which the typical blebs of gangrene were to be seen.

As evidences of gangrene, the thumb showed a deep purplish color, was somewhat withered, evidently in the early stage of gangrene.

Circulatory changes: Although the postero-external aspect of the forearm was fairly warm, the internal aspect changed color, suggesting a possible future necrosis. Between the thumb and the dorsal trophic disturbance, over the thenar eminence and thereabout on the posterior surface, there was a peculiar ham-colored red with diminished temperature due to marked circulatory disturbances. The four fingers, however, were in fairly good condition, their color good, and the patient could move them.

The following notes were furnished me through the courtesy of Dr. P. Aschner.

February 23, or 6 days after thrombectomy—slight wrist drop developed, and there were definite sensory and motor phenomena, said by the neurologists to have been due to implication of the ulnar and musculospiral nerves. In the region of the brachial wound there was some induration, possibly due to deep infection.

March 8, chill and rise of temperature to 105.4° with a negative blood culture, the fever disappearing in 24 hours. March 12, again chill and temperature to 106°, and the blood culture showed hæmolytic streptococci. March 16, some pus was evacuated from the brachial wound. An abscess of the right thenar space was evacuated on March 18; and, on March 20, the temperature gradually attained the normal by lysis.

April 7, the gangrenous area of the thumb had become well demarcated, and the terminal phalanx was disarticulated. A few days later the patient was discharged from the hospital.

In May of the same year the condition of the hand and forearm was as follows:—it was atrophic, weak, of a dusky red color, and the fingers purplish. There were trophic disturbances of the nails, which were discolored and poorly nourished. Hyperhidrosis was also present. In the dependent position, paræsthesia and pain were very severe. Neurological examination demonstrated marked impairment of the motor and sensory functions of the median and ulnar nerves. There were still small sequestra at the site of amputation, and these were spontaneously extruded in the course of the next 4 weeks.

Postular exercises and electrical stimulation were given. Improvement rapidly took place, so that in a month the fingers could be semiflexed. Three months later a normal range of motion was reestablished, the atrophy of the muscles was almost abolished, and the color and texture of the skin approached the normal.

It was reported[1] that on September 7, 7 months after the vascular occlusion, the radial pulse had returned (through collaterals?); one month later the patient was able to resume his work as a chauffeur.

Although successful from the purely technical standpoint, the radial pulsation was not restored until late, due to the presence of thrombi distal to the site of the embolism. Nevertheless, the operative procedure served a purpose in that an additional part of the brachial became patent, and the source of collaterals thereby widened.

In view of the presence of a bacteriæmia, there obtained here an additional factor (probably toxic) predisposing to the extension of thrombi. It has been often observed by the author that stagnation thrombosis may spread rapidly from emboli in the larger arteries in cases of pneumonia and influenza, while the field of obturation is more apt to remain restricted and anastomotic paths conserved in pure cardiac disease and atherosclerosis.

The question of removal of the embolus, therefore, should be entertained *very early* wherever an additional toxic element may vitiate the result. In the above case, although the first clinical manifestations of embolism were noted but about 3½ hours before the operation, the occlusion was doubtless of at least 10 hours' duration, judging from the appearance of the clot. This may be too late; for, on the one hand, time is given for the detachment of clot through the action of reflux currents and motion of the limb into more remote territories, and, on the other, rapid growth of the clot by stagnation, abnormal currents and vortices, and through the forces of ferment liberation, may be expected.

[1] Personal communication from Dr. Aschner.

DIVERTICULITIS OF THE GALL BLADDER

By GEORGE KNAPP ABBOTT, A.B., M.D., Sanitarium, California

INTESTINAL diverticulitis is no longer a postmortem curiosity. From a matter of pathological interest only, it has assumed a place of some clinical importance. Originating in many cases at least in a small mucous ulcer, it gradually deepens until, with inflammatory thickening of the colonic wall and continued ulceration, it becomes a narrow pocket projecting beyond the normal contour of the intestinal serosa. This pocket retains fæcal matter often for days at a time, as shown by barium meal and X-ray examination. It becomes highly vascular and greatly thickened. Not to be confounded with this type of intestinal pathology is the non-inflammatory herniated pouch such as is occasionally found in the duodenum and in other locations. These are usually larger, thinner walled, and show little or no evidence of inflammation or infection. They appear to arise as mucosal hernias through the weakened and separated muscular and fibrous elements of the intestinal wall. I have encountered such at the junction of the transverse and ascending portions of the duodenum. They may be pre-operatively diagnosed by X-ray, having been suspected from the history and symptomatology, and are readily remedied by direct hernial repair of the intestinal wall.

Diverticula of the urinary bladder are indeed very common. They are for the most part due to increased intravesical tension, though occasionally seemingly congenital, and frequently show the changes of cystitis. The diagnosis and surgical treatment of vesical diverticula are well known to the specialist and general surgeon. Diverticula are also encountered in the œsophagus, and have been very thoroughly described by Plummer and others.

With these brief references to diverticulosis and diverticulitis of the œsophagus, intestine, and urinary bladder, I wish to report a case of diverticulitis of the gall bladder. This was not encountered in a highly pathological gall bladder, nor was it merely a pouch due to pressure of gall stones. The entire fundus of the gall bladder itself showed no discernible pathology on gross examination. So normal did it appear that before the diverticulum near the neck of the gall bladder was discovered, I was inclined to think some gross blunder in diagnosis had been committed.

Case No. 10,667 (St. Helena Sanitarium and Hospital), December 28, 1921. J. H. D., a married female, age 35. Complaint—pain under right costal arch. Patient's father had Pólya operation for carcinoma of greater curvature of stomach in 1919, and is still living and well. The mother is living; has much digestive disturbance. An uncle and one grandfather died of tuberculosis. Patient has not been in good health since age of 16. She had malaria at 17, and arthritis, mild, off and on from 1906 to 1910. Formerly had had much tonsillitis, and sore throat occasionally now. She has had no other infections. The left tube and ovary were removed in 1910. Menses were of the 3-day type, 28-day interval; irregular, and mostly early for the last year.

Pain has been present in right side for past 2 years or more, mostly under right costal arch, occasionally in back. The pain is described as a gnawing sensation—not overly severe. A feeling of soreness is present almost all of the time, and especially after working or lifting. Not much gas on stomach. Pain is not related to meals. Patient complains of urinary burning at times; gives a history of "cystitis" in 1919.

Examination. Overweight female; present weight 155 pounds—having gained 30 pounds in last 2 years. Mouth: oral hygiene good, two pieces of crown and bridge work; X-ray shows two apical abscesses. Tonsils cryptic and contain cheesy matter; no cervical adenopathy. Heart: negative. Lungs: negative, except X-ray shows hilus thickening slightly excessive. Abdomen: marked percussion sensitiveness over entire right and left lumbar regions; no especial tenderness over gall-bladder or appendix regions; no notable findings elsewhere. Barium meal shows nothing except a "picking up" of the duodenum in the region of the gall bladder.

Laboratory findings. Blood: hæmoglobin 85 per cent; reds, 4,950,000; whites, 7,400; blood pressure 110-75 millimeters mercury; Wassermann, negative. Urine: negative, except few pus cells. Fractional test meal shows normal curve of hydrochloric acid secretion—no residue.

Diagnosis (pre-operative): cholecystitis with duodenal adhesion; apical abscesses; and chronic tonsil infection.

Recommendations: Cholecystectomy, extraction of abscessed teeth, and tonsillectomy. Teeth extracted January, 1922; laparotomy May 26, 1922. Incision—upper right rectus. Appendix removed; no gross pathology visible. The gall bladder appeared perfectly normal. A little more search revealed an apparent binding of neck of gall bladder to duodenum. In gross appearance this seemed not inflammatory. On releasing it, a small, thickened mass of gall-bladder tissue was revealed. The entire gall bladder was removed, and the cystic duct and artery ligated. A rubber tubing drain was placed and the abdominal wall closed in layers. The drain was removed the fourth day. Convalescence was uneventful. Examination of the gall bladder showed the inflammatory mass to consist of a diverticulum about one-fourth inch in diameter and one-half inch deep. The walls of the diverticulum were greatly thickened and inflamed. There were no gall stones.

The remarkable feature of this case was the presence of a markedly inflamed diverticulum arising from the neck of the gall bladder,—the entire gall bladder otherwise being perfectly normal in appearance.

ANGIOMYOMA OF THE URINARY BLADDER

By FRANK KIDD, M.A., M.Ch. (Cantab.), F.R.C.S., London, England
Late Surgeon to the London Hospital; Member of the International Society of Urology; Membre de l'Association Française d'Urologie
AND
Dr. HUBERT M. TURNBULL
Director of Pathological Institute, London Hospital

CASE HISTORY

DATE, November 8, 1921; subject, a male aged 29 years.

Onset of present illness two years previously when acute retention of urine was relieved by catheter. Since that time he has had several relieved attacks of a similar nature. Four months ago he had a severe attack; catheter passed four times; bladder infected; followed by great pain on passing water, increased frequency and pyuria. Slight hæmaturia was noticed once or twice after a catheter had been passed. No venereal history.

Examination. Nervous system healthy. The urethroscope shows no stricture. Roentgenograms show no stone. Cystoscopy shows urine full of pus, bladder very irritable, bladder wall very much inflamed. A smooth pedunculated tumor can be seen attached to the anterior wall of the internal meatus, projecting from there into the bladder.

After a course of vesical lavage I performed an operation on November 30, 1921, under ether and oxygen anæsthesia.

Operation. The bladder was opened in the middle line and its cavity exposed by an automatic retractor with electric light attached. A smooth pedunculated tumor could be seen arising from the anterior portion of the margin of the internal meatus as shown in the illustration. It was about the size of a date and looked like a ripe raspberry, being obviously full of blood vessels. The pedicle was seized with a curved clamp and pulled forward and upward until a second clamp could be placed well behind the pedicle. The tumor was then sliced off between the two clamps, no ligature being needed. The bladder was stitched up as usual and drained with a small Pezzer tube. The abdominal wall was repaired and covered with strapping over a light dressing.

Course. Lavage with 1:8000 acriflavine through the tube soon put an end to the cystitis. The tube was removed on the tenth day and the fistula healed soundly within less than a fortnight, though convalescence was complicated by an attack of bronchitis. Thereafter the patient passed clear water naturally and with no difficulty or pain and since then he has remained perfectly well. He was seen on March 13, 1922. He could hold water all night, the urine was clear and the stream was free.

A drawing made immediately after the operation represents very fairly the condition seen (Fig. 1). Sections were cut, and illustrations of typical portions are shown. These sections were made the subject of a special study by Doctor Hubert M. Turnbull of the Pathological Institute of the London Hospital, to whom my thanks are due. The report is as follows:

Sections cut from the paraffin block were stained with Ehrlich's hæmatoxylin and eosin, Weigert's iron-hæmatoxylin and van Gieson's mixture, Weigert's fuchselin and neutral red, the Unna-Pappenheim mixture, polychrome methylene blue, dilute carbol-fuchsin, and by the Weigert-Gram method with and without neutral red.

The specimen is an oval polyp with a narrow stalk. The polyp near the stalk is covered by a transitional epithelium composed of five to ten layers of cells. This epithelium lines a few gland-like depressions. Similar epithelium covers one surface of the stalk. As the summit of the polyp is approached, the epithelium thins rapidly and is finally absent. The ulcerated surface is smooth; upon it lies a little

fibrin containing red corpuscles and shreds of necrosed epithelium.

Beneath the epithelial and the ulcerated surfaces is a zone of tissue composed of delicate collagenous and elastic fibers; the zone is in general deep, and is deepest upon the summit of the polyp. The fibers are widely separated by œdema. The superficial layers are infiltrated with numerous neutrophile leucocytes, red corpuscles, and fat-granule cells; in the deeper layers these cells give place to plasma cells. The zone contains numerous, greatly dilated, engorged capillaries and veins. The zone is continued over the stalk as a narrow, subepithelial layer, in which infiltration and engorgement are absent while the collagenous fibers are stouter and much more closely packed.

The center of the stalk and the core of the polyp are occupied by bundles of involuntary muscle and numerous large arteries and veins, in a matrix of stout collagenous and stout elastic fibers. The elastic fibers are specially numerous about the bundles of muscle and thus form a sheath to the bundles; they form a less conspicuous adventitial sheath to the vessels. The muscular and elastic elements in the vessels are normally arranged. The bundles of muscle are directed approximately in the long axis of the polyp. They contain a few delicate, elastic fibers. They are completely separated from the vessels by the matrix described above. The matrix, within the polyp, is infiltrated with numerous mast cells.

The only organisms detected were a few oval, yeast-like, Gram-positive cocci, measuring from 1 to 1.2μ by 0.6 to 0.8μ. They were almost all extracellular and lay in the superficial zone.

Interpretation of microscopic findings. The polyp is acutely inflamed, but its complicated structure shows that it is not a sprouting granuloma. The inflammation is a secondary phenomenon and has been excited from the surface, as is demonstrated by the distribution of the infiltrating cells. The structure of the polyp is essentially similar to that of the bladder. The epithelial covering resembles that of the bladder in structure and depth. The œdematous, inflamed, outer zone has the structure of the mucosa of the bladder. The central core resembles the muscularis of the bladder, except in that it contains abnormally large and numerous vessels; the size and number of these vessels is very striking when comparison is made with a section of normal trigone. The muscle bundles are not connected with the formation of the vessels, as is the case in some angiomata; the vessels are perfectly formed and are absolutely distinct structures.

The polyp is, therefore, an excrescence of muscularis, mucosa, and epithelium, supplied with abnormally large and numerous vessels. It is difficult to find a satisfactory nomenclature. Inasmuch as the polyp consists of a protrusion of the wall of the bladder in which the component parts, including the vessels, are normally arranged and related, and are apparently directly continuous with the same components within the wall of the bladder, such as "leiomyoma" and "angioma" are excluded by the accepted definitions of true neoplasms. The polyp is an error of development rather than a neoplasm as usually defined. This could be expressed by the term "hæmartoma." But to distinguish it thus from certain accepted benign neoplasms, such as polypoid fibro-adenomata of the intestinal tract and villous growths of the bladder, would be to make a distinction with little appreciable difference. To the designation "papilloma" there could be little objection were it not that this name is commonly applied to tumors in which epithelial proliferation plays an important part. This objection would perhaps be overcome by calling it a "polypoid papilloma of muscularis of bladder." To draw attention to the excessive development of vessels, the qualification "vascular" might be added: "polypoid, vascular, papilloma of muscularis of bladder."

Accurate classification of this tumor is a matter of difficulty. It is undoubtedly a benign tumor and it consists chiefly of an overgrowth of blood vessels and of unstriped muscular fibers. It is not a simple myoma, nor is it a "papilloma" of epithelial origin in the ordinarily accepted sense. Perhaps the term "angiomyoma of a polypoid papillomatous form" is the nearest definition that can be attempted.

The best account of non-epithelial tumors of the bladder that I have been able to find is in Howard Kelly and Curtis Burnam's book *Diseases of the Kidneys, Ureters, and Bladder*, 1914, vol. ii, chap. xxxvii. Kelly describes growths of the bladder which spring from its muscle fiber or connective tissue, namely, myxoma, fibroma, sarcoma, myoma, rhabdomyoma, angioma, dermoid and chondroma. Myxoma is found chiefly in childhood and is very rare. Fibromyxoma is rare and usually occurs in childhood; Kelly reports three cases from the literature.

Fibroma is a little less rare, originates in the submucosa and grows out into the bladder. Its distinguishing feature from papilloma is that the main vessels run between the mucosa and the tumor, and do not plunge directly into the body of the tumor. Clado cites 25 cases, Legueu adds 3 and Judd[1] adds two more.

Sarcoma may occur at any age, 10 per cent only in childhood. Albarran collected 53 well established cases from the literature.

Myomata may grow into the lumen of the bladder and become pedunculated, they may

[1] J Am. M. Ass., 1912, lix, 1788.

occupy the wall of the bladder or they may push their way to the outside of the bladder. Albarran collected 21 cases, and Judd found two in 114 cases of bladder tumor observed at the Mayo Clinic.

Angioma. Kelly reports one doubtful case observed in 1851, one postmortem case worked out by Albarran in 1892, and a case reported by Robert C. Bryan[1] which was operated upon.

Angioma is therefore one of the rarest if not the rarest tumor arising in the urinary bladder. The only case I can find which closely corresponds to the one I have described is a case of angiomyxoma reported by E. S. Judd and S. W. Harrington.[2]

CASE REPORT

A woman, age 19, complained of incontinence of urine, which began 2 years previously, and stated that there had been blood and pus in the urine for 2 weeks.

Physical examination showed a large cystic tumor. Catheterization seemed to reduce this mass to about three-fourths of its original size. Pelvic examination revealed a mass behind the bladder. Cystoscopic examination showed a large tumor mass involving the right wall and base of the bladder and attached around the sphincter. The left meatus was normal; the right was not seen.

Operation. Stage I. Extraperitoneal removal of an enormous polypoid tumor filling a greatly hypertrophied bladder. There was an opening in the right anterior wall of the bladder through which the growth extended into the right extravesical space.

Stage II. An extravesical growth the size of a grape fruit was excised and the opening in the bladder, two inches in diameter, was closed. The pathological diagnosis was papillary angioma. The patient was recovering when last seen.

A case of angioma of the bladder which does not correspond very closely to this case is reported by Launay, Achard, and Carriere.[3]

A woman, complaining of pains in the right iliac fossa which were sharp and intermittent, of imperious and painful micturition, and of intermittent hæmaturia, was brought to the hospital. Examination showed that the pain in the right iliac fossa was greatest at McBurney's point, and that the uterus was scarcely movable. The case was diagnosed as appendicitis.

Operation. A median subumbilical incision was made. On opening the peritoneum, a lobulated hard tumor the size of an orange could be seen on the posterior and right lateral face of the bladder. A

[1] Tr. South. Surg. & Gynec. Assn., 1909, xxii, 578.

[2] Tumors of the urinary bladder. South M. J., 1918. xi, 129.

[3] J. d'urol. méd. et chir., Par., 1920, ix, 385-390.

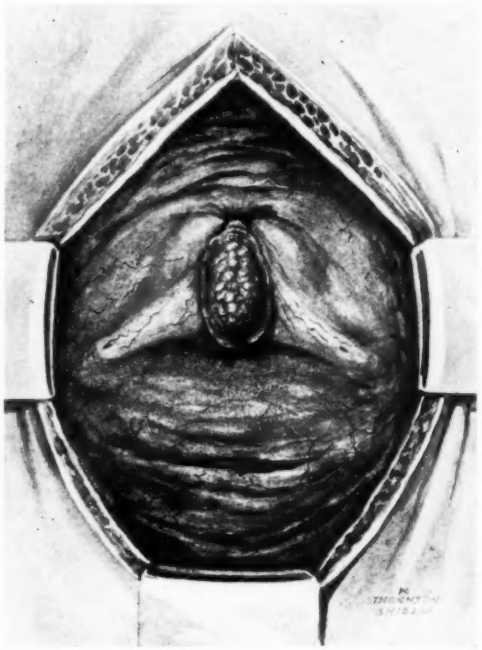

Fig. 1. Drawing showing condition in authors' case.

partial cystectomy was performed and the whole tumor removed. The bladder and the peritoneum were closed, a drain being first placed in the peritoneal cavity. Three weeks later the patient left the hospital.

Macroscopic appearance of the tumor. It was divided into two parts, one part globular and very hard and the other a glossy surface, softer than the first part.

Microscopic examination. The subperitoneal part of the tumor was made up of connective tissue in which the blood vessels were dilated and filled with blood. In the cystic part of the tumor the connective tissue was infiltrated with small blood clots.

Albert J. Scholl, Jr.,[4] in a paper from the Mayo Clinic, "Histology and Mortality in Cases of Tumor of the Bladder," reports as follows on "angioma of the bladder":

"Angiomata are rarely found in the bladder. They may be small, and their only symptom a persistent, profuse hæmaturia; or they may be extensive, penetrating into the perivesical tissues, and simulating growths of other pelvic organs. In most cases they are composed of anastomosing dilated cysts filled with blood;

[4] Surg., Gynec. & Obst., 1922, xxxiv, 189.

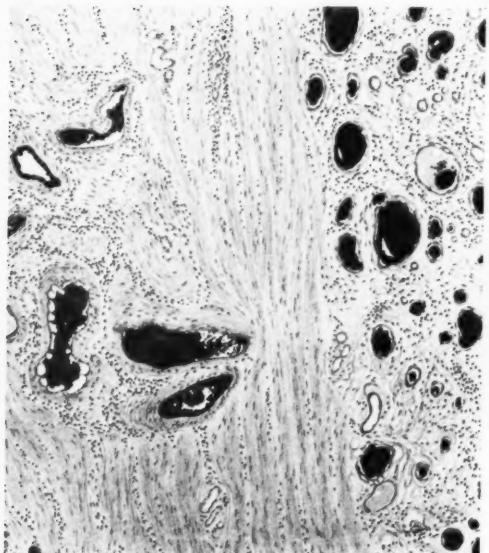

Fig. 2.

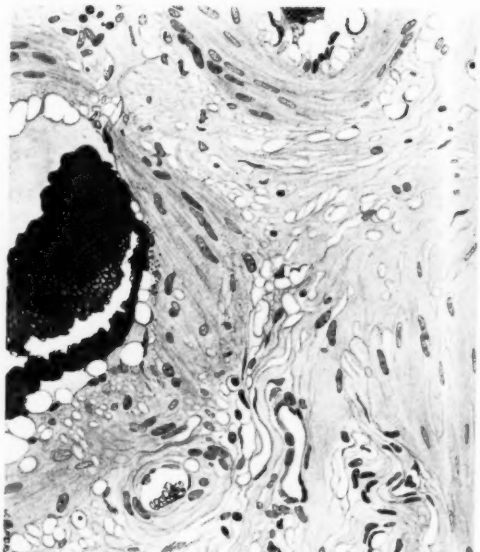

Fig. 3.

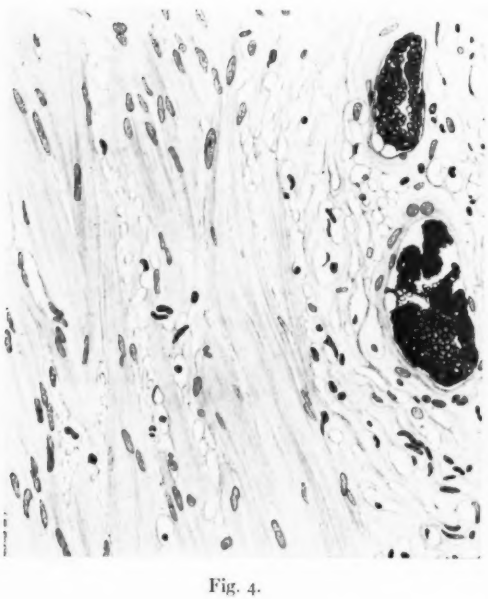

Fig. 4.

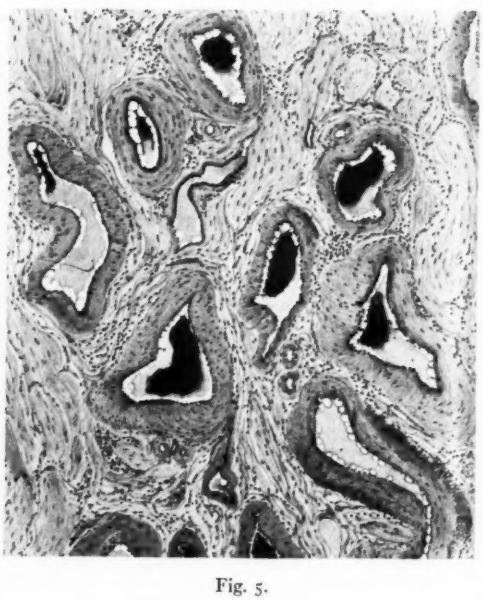

Fig. 5.

Figs. 2 to 5. Microscopic sections in authors' case.

rarely they occur as branching masses of apparently recently formed blood vessels, supported by a fibromyxomatous stroma. Watson found only two angiomata in 653 collected cases. Albarran collected three cases from the literature and reported one of his own which occurred in a series of 106 cases observed personally. In Albarran's case the tumor, which he removed surgically, was very small; it was attached to the trigone and bled profusely. Thomas has described a similar small angioma which was removed by fulguration. Lane has described a large inoperable cavernous angioma in a child of 3 years. Jungano has described a massive cauliflower angioma in the region of the trigone undergoing sarcomatous degeneration in a man aged 54 years. Launay has reported the case of a girl aged 19, in whom a large submucous angioma was removed from the postero-lateral wall of the bladder. The tumor was firm in spite of many cavernous dilatations.

"In the series of 262 cases there were three angiomata:

"A girl (Case 14928, Fig. 15), aged 19 years, had had pus and blood in the urine, and mild incontinence for 2 years. At operation a large polypoid tumor was found filling an enormous bladder. The tumor extended into the perivesical space through an area about 3 centimeters in diameter. The tumor was completely removed. Four months later a small recurrent growth was successfully fulgurated. Five years later the patient was in excellent health; her bladder appeared normal and its function was normal. The tumor in this case was firm, and contained many blood cysts and sacculations, but the larger part of the growth was composed of fine interlacing blood vessels supported by connective-tissue stroma, simulating a highly vascular myxoma.

"A man (Case 151866, Fig. 16), aged 76 years, had had occasional attacks of hæmaturia and moderate frequency for the last 8 months. On examination an inoperable sessile growth covered with papillomatous excrescences was found on the left base of the bladder reaching up to and involving the urethral sphincter. The growth was extensively fulgurated. Seventeen months later, after a period of comparative relief, the urinary symptoms returned. Examination revealed a wide-spread mass covering the entire left half of the bladder and involving the prostate and posterior urethra.

"A girl (Case 18434), aged 7 years, had had persistent slight hæmaturia for 6 years; recently a small amount of blood had passed from the rectum. A mass 6 centimeters in diameter was palpated in the region of the bladder. Cystoscopic examination revealed an ulcerated bleeding tumor in the base of the bladder. Soon after, before operation could be performed, the patient had a severe hæmorrhage from the rectum and died. Necropsy revealed an extensive cavernous angioma growing from the base of the bladder and invading the rectal mucosa."

CONCLUSIONS

1. Angioma or angiomyoma is probably the rarest type of tumor met with in the urinary bladder.

2. If a diagnosis can be made at an early stage, operation may be successful and should lead to a permanent cure.

3. If not detected until a late stage, an operation may be impossible and death may occur from hæmorrhage.

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PRIMARY CARCINOMA OF THE URETHRA

By HARRY CULVER, M.D., AND N. K. FORSTER, M.D., CHICAGO
From the Department of Cystoscopy, Skin and Venereal Diseases, Cook County Hospital, Chicago

THE occurrence of carcinoma primarily in the urethra of the male or female is sufficiently rare to warrant a review of published cases and a report of three such instances of our own.

Riberi has been credited with reporting the first case of cancer of the female urethra in 1844, but Percy states that Bowin first described this condition in 1833. M. Wassermann (1), in his thesis in 1895, collected 24 cases; Serph (2) 30 cases in 1901. Percy (3), after a critical study of the literature in 1903, considered that there were only 12 undoubted instances, and that 3 of these were sarcomata. He excluded all those with involvement of anatomical structures other than the urethra. Many of the cases reported in the literature are quite incomplete, and in the majority the growth had extended greatly beyond the urethral focus. Karaki (4), in 1908, collected 53 reports; Whitehouse (5), in 1911, found only 43 records of undoubted urethral cancer in the woman. Venot and Parcelier (6), in 1921, gave the histories of 87 instances collected from the literature, and 1 case of their own. In addition one or more cases have been reported by Eicke (7), Boyd (8), Menge (9), Franke (10), Croft (11), Ball (12), Boursier (13), Hirst (14), Gibson (15), Fairbairn (16), Engelhardt (17), Maiss (18), Horand (19), Bachrach (20), Starck (21), Watson (22), Crossen (23), Shoemaker (24), and O'Neil (25).

Accepting the collection of Venot and Parcelier as the most accurate recent compilation, together with the additional cases found in the literature and not quoted by them, and considering all cases reported under the heading of urethral carcinoma, whether they arose from polypoid degeneration, or where neighboring structures were involved, we find reported 120 instances of this type of new-growth.

The incidence is not so great in the male. Hall (26) collected a series of reports up to 1904. Preiswerk (27), in 1907, compiled 42 instances from the literature, but omitted 6 of Hall's cases. In a criticism of the subject Conforti (28) thinks that 4 of Preiswerk's cases ought not to be admitted, as they were reports of epitheliomatous fistulæ. O'Neil (25) added the reports of 10 cases in 1921. There are, however, several records in the literature not included in any of the papers mentioned. Barabino (29), Malanssene (30), Ottow (31), Olivier and Clunet (32), Allenbach (33), Bierbaum (34), Rizzi (35), Menocal (36), Remete (37), Yves Tizon (38), Conforti (28), Kroiss (39), Shattuck (40), Tansini (41), and Burckhardt (42), have added one or more reports to the total, bringing the number to 73. To these we wish to add the reports of 3 cases of our own, two occurring in the female and one in the male.

CASE 1. M. H., a widow, age 65, admitted to Cook County Hospital on May 12, 1922, complaining of pain in the left lower quadrant of the abdomen and left flank, pain and difficulty in urinating, and general weakness.

For the past 2 or 3 years the patient had suffered from urinary disturbances consisting of frequency and burning on urination, and for which she had never consulted a physician. For the past 3 weeks she had been complaining of the pain in her left side and abdomen, and this had become progressively worse, radiating into the left thigh. It was of a dull, aching, constant character, occasionally accompanied by sharp, shooting, cramp-like pains. Her weakness had been a progressive one, finally marked by a semi-comatose condition the greater part of the time. She had never made any complaint of a tumor growth, or of any symptoms referable to the genito-urinary tract beyond the frequency and burning on urination. Recently this frequency had become very pronounced, with nocturia of three or four times.

There was no history obtainable of any previous illnesses, and the family history so far as could be determined was negative for carcinoma. Her menstrual periods began at 17, and were apparently normal up to the time of her menopause at 52. She had been married for 40 years, and had given birth to six children.

Physical examination revealed a poorly nourished adult white female, very anæmic, and appar-

Fig. 1. Case 1. Drawing showing the enlargement of the urethra as seen from the exterior.

ently very weak. The essential findings consisted of marked emaciation, abdominal tenderness, especially in the left lower quadrant and extending as high and laterally as the lumbar region and accompanied by muscular rigidity and some fullness in the flank, and the findings on vaginal examination. The introitus was relaxed and the opening gaping. The examining fingers encountered a firm, nodular mass apparently surrounding the urethra, but not involving the vaginal mucosa, and extending as far as the neck of the bladder. This mass was estimated to be about one-half inch thick. On introduction of a small sound into the urethra the mass was further accentuated, and so far as could be determined surrounded the urethra throughout its course. The meatus was markedly enlarged, but externally there was no evidence of tumor growth. The uterus was small and atrophic, and exhibited a small cervical polyp, which on removal and histological examination showed no evidence of malignant degeneration. The cervix was otherwise normal as were the adnexa. Cystoscopic examination revealed the presence of a marked generalized hæmorrhagic cystitis, with some bullous œdema about the vesical neck, but no evidence of tumor growth intravesically. Catheterized urine specimen showed the presence of albumin and a large number of pus cells. The white blood cell count was 7,900. A diagnosis was made of primary intra-urethral carcinoma, with secondary pyonephrosis.

The patient's condition precluded any operative interference, and exitus was inevitable. Autopsy examination was performed with the following anatomical diagnosis: primary carcinoma of the urethra with extension metastasis to the neck of the bladder; bilateral pyonephrosis; chronic diffuse nephritis; petechiæ of the renal pelves and beginning of the ureters; dilatation of the renal pelves; moderate œdema of the lower lobes of the lungs; senile atrophy of the spleen, fallopian tubes, ovaries and uterus; fibrosis of the aortic leaflets; slight senile arteriosclerosis; old healed tuberculosis of the apex of the left lung (Figs. 1 and 2).

Microscopic examination of a cross section of the urethra presented the picture of a very malignant process. Numerous mitotic figures were seen, and direct extension of the cancer cells had irregularly taken place deep into the urethral musculature. At the vesical neck only had the process extended beyond the limits of the urethra. Here the sphincter of the bladder was involved by direct extension, but the vesical mucosa was everywhere free from new-growth (Fig. 3).

Case 2. Mrs. T. A. V., age 38. With the exception of typhoid fever at the age of 12 years, there had been no previous disease or accident. Her first complaint relative to her present condition had occurred 7 months before her examination by us, and consisted of painful sexual intercourse. This symptom rapidly became more severe, and within 2 months from the time of its appearance it was impossible to perform this act. At about this time it was observed by the patient that there was a vaginal protrusion. An attempt was made by a physician to replace this mass but without success. Nothing further was attempted in the way of treatment, and during the next 2 months a constant pain in the "region of the neck of the bladder" developed, which was markedly increased on sitting down. During the next 3 months this symptom increased only moderately in severity.

One month from the beginning of the symptom of pain, there occurred a gradually increasing frequency of urination which developed to such an extent that within 4 months there was both nocturnal and diurnal partial incontinence of urine. There has been no hæmaturia or loss of weight, but a considerable loss of strength during the 7 months following her initial symptom.

Examination found a well-nourished, middle aged woman, whose general physical condition was normal. Locally there was an elongated rounded mass in the region of the urethra extending back into the vagina to within 1 inch of the uterine cervix. The consistency of this mass was constantly firm, and its outline regular. The mass was so extensive that the examining fingers were inserted into the vagina with difficulty, even when the patient was under a general anæsthetic. On cystoscopic examination the urethral meatus was normal. A No. 18 F. cystoscope was passed with moderate obstruction, and there were 4 ounces of residual urine in the bladder. The vesical mucosa was normal except for œdema about the vesical neck. Urethroscopy revealed a markedly irregular and hyperæmic urethra throughout its course. Considerable oozing of blood was noted along the entire urethral tract. A diagnosis of primary intra-urethral carcinoma was made, but not confirmed by biopsy as it was decided to treat the condition with radium.

Fig. 2. Case 1. Drawing showing the interior appearance of the bladder and urethra. Note the ulceration in the lumen of the urethra, also the marked trabeculation of the vesical wall. No tumor tissue is seen within the bladder.

On April 24, 1922, 2600 milligram hours of radium by means of a vaginal pack was applied. There was no constitutional or local reaction. On May 15, there was no apparent change in the character of the tumor, although there was some improvement in the symptoms. On this date 1200 milligram hours of radium by means of radium needles were inserted into the urethra from the borders of the external meatus. There was no constitutional or local reaction for 2 weeks, at the end of which time ulceration was definite, and there occurred a sloughing of the entire urethra, without apparent damage to the vesical sphincter. One month from the last application of radium acute retention of urine developed, which was soon followed by an overflow bladder. Two months from the last application of radium the general condition is excellent, the pains have entirely subsided, and the bladder is constantly emptied by means of a vesicovaginal fistula, which has been present for 6 weeks.

Case 3. Mr. W. G., a laborer, Irish, age 71, entered Cook County Hospital November 8, 1921, complaining of pain in the penis, swelling of the penis, and difficulty in urinating. He stated that at the place where he had been working he had accidentally been scalded by a stream of steam about 11 months previously. The pain from this had been very severe at the time, but had gradually abated with the exception of a dragging-down sensation which had persisted. About 3 months after the accident, he first noticed that the under surface of the penis near the glans began to get hard, and this area of firmness

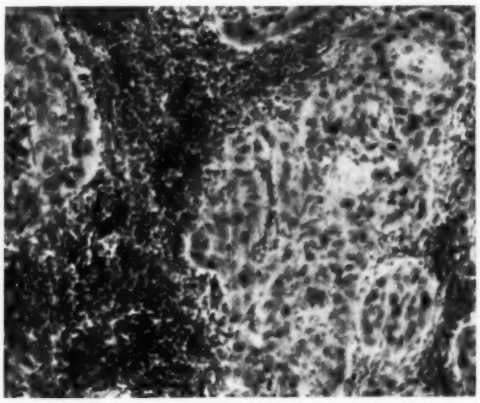

Fig. 3. Case 1. Typical field from a cross section of the urethra. Mitotic figures are seen in the cancer cell groups. Marked round-cell infiltration is noted throughout the tissue. (×135.)

had increased in size until it involved the greater part of the distal half of the penis, but did not involve the glans or skin surface. Difficulty in urinating had been present for the past 2 weeks, and during this period he had been sounded several times by a physician with some relief, though it was generally necessary for him to strip the penis in order to clear the urethra from retained urine. Accompanying the difficulty there had been considerable burning pain on urination. He felt that he had been getting very much weaker lately, and had lost about 10 or 15 pounds in weight. Beyond the usual diseases of childhood he had never had any serious illnesses, and his family in general had all attained a very old age, and in none of them could he remember the occurrence of cancer.

Physical examination revealed a fairly well developed, rather poorly-nourished, adult white male not appearing acutely ill but seemingly very weak. The essential findings were confined to the genitourinary tract. The penis exhibited a cord-like, indurated mass extending from the corona of the glans to the penoscrotal junction, along the under and lateral surfaces. The skin was not involved, sliding easily over the shaft of the penis. The urinary meatus was somewhat reddened but showed no evidence of tumor tissue, nor was the glans involved. A very fine stream was passed on urination, the act causing some burning and pain. Both testicles were present in the scrotum and with the epididymides presented no abnormal findings. Rectally the prostate was very slightly enlarged, smooth, regular, and not tender. The seminal vesicles were apparently normal. Bilateral inguinal indirect herniæ were present, together with a moderate inguinal adenopathy. Beyond a moderate degree of arteriosclerosis and the usual senile changes, further physical findings were entirely negative or normal.

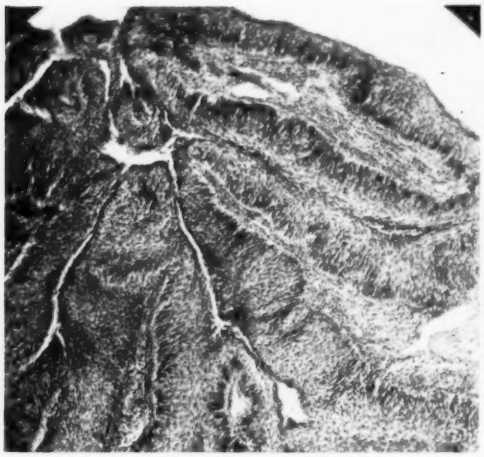

Fig. 4. Case 3. Showing definite papillary protrusions pointing toward the urethral lumen.

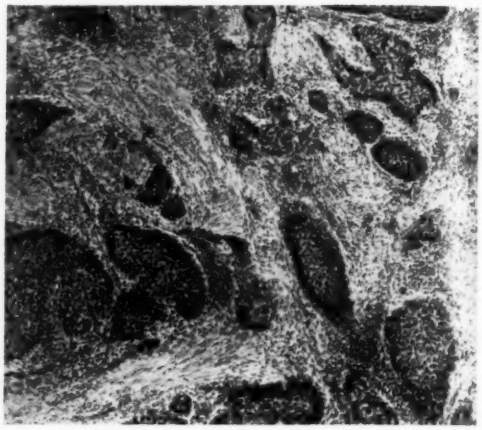

Fig. 5. Case 3. From same section as Figure 4 but deeper into the urethral tissue, showing the invasion of corpus spongiosum by cancer cells (× 60).

Urine examination showed the presence of albumin, a few red blood cells, many pus cells, but no casts. The blood Wassermann was negative. Blood cell count showed 4,100,000 red cells; 9,200 white cells; hæmoglobin 68 per cent. Blood chemistry examination gave the following figures: urea nitrogen 17.62, urea 37.70, creatinine 1.62, sugar 75.00. Diagnosis of carcinoma of the penis primary in the urethra was made, and radical amputation with the establishment of a perineal urethral opening decided upon and done.

Histopathological examination of the removed organ showed extensive infiltrating masses of large atypical cells arranged in rows forming definite papillæ which extended into the lumen of the urethra. Many such cells were seen invading the corpus spongiosum. The microscopic picture as a whole suggests a neoplasm of relatively low-grade malignancy, and must be classified as a papillary carcinoma of the urethra (Figs. 4 and 5).

The patient had a rather stormy convalescence, but eventually left the hospital in good condition. The wound had healed by primary union, but there still persisted some urinary incontinence and considerable discomfort from the leakage of urine. However, 6 months from the time of the operation the patient was seen again. He stated that he had perfect control over urination, all burning and distress had stopped, his appetite was good and he had put on about 15 pounds in weight. It had been our original intention to complete the operation by the removal of the inguinal chain of lymph glands, and on leaving the hospital the patient had been instructed to return at intervals for X-ray treatments which he neglected to do. However, the glands at this time were practically of normal size, their former enlargement undoubtedly having been due to inflammatory changes rather than to metastasis. The clinical result is in accord with the microscopic finding of a relatively low-grade malignancy.

Venot and Parcelier discuss the question as to what should be described under the title of carcinoma of the urethra, and conclude that if only the cases in which the urethra alone is involved should be admitted, then there are only fourteen instances of primary carcinoma of the urethra in women reported in the literature. But as a matter of fact patients are not usually seen until the disease has already greatly surpassed its limit of origin. The same is equally true in the male where retention of urine is not a marked early symptom. Consequently the opportunity of observing urethral cancer in its initial stage is rarely obtained.

Ehrendoerfer (43), and others, have desired to create two categories of urethral carcinoma: (a) urethral cancers, properly so called, originating at the expense of the urethral epithelium or its glands; and (b) those originating at the expense of the epithelium surrounding the meatus, and secondarily involving the urethra.

In considering carcinoma of the female urethra, Venot and Parcelier accept this classification with reservations and state that there may then be:

1. True urethral types, which may be:

a. Ulcerous type, which is rare, only three cases being recorded;

b. Infiltrative type, somewhat more common, although Percy found but 16 cases in 1903; Karaki, 19 in 1908, while Whitehouse in 1911 admitted only 11.

2. Vulvo-urethral types, which may be:

a. Polypoid or papillary, some 15 reported instances having been found to belong to this class;

b. Ulcerous, in which the neoplasm starting from the meatus or its vicinity, hollows out and destroys all the neighboring tissues. They have found 7 cases exemplifying this type in their investigation;

c. Infiltrative type, that in which the neoplasm invades the tissues step by step. It is the type most commonly met, and usually begins as a small meatal tumor, soon invading the vestibule, urethrovaginal septum, and surrounding structures.

The same classification, with suitable alterations, may be applied to the male. The true urethral types arising from the urethral epithelium or its glands, and being either of an ulcerous or infiltrative character; and the para-urethral types arising from the epithelium surrounding the meatus, and involving the urethra secondarily. This latter may be of the ulcerous character, such as is rarely seen following chancroidal infections with subsequent malignant changes; or of an infiltrative type, spreading from the glans or surrounding structures and gradually involving the urethra; and finally those cases resulting from the malignant degeneration of papillomata in the region of the meatus.

Histopathologically the cases are squamous, columnar, or adenocarcinomatous in type, the latter being the most uncommon. Watson (22), states that according to Whitehouse (5), squamous-celled carcinoma is the preponderating type of growth, Of his 43 collected cases, 27 were of this variety; 2 are described as a combination of epithelioma and columnar-celled carcinoma, while adenocarcinoma is rare, originating in the peri-urethral glands, and only 14 cases being reported.

As in malignant tumors elsewhere in the body, the direct cause is wanting. Reports indicate susceptibility in ages ranging between 40 and 60 years, for both sexes. Leucoplakia has been considered by some authors as important. Caruncle as a forerunner is undoubtedly of considerable consequence, although mentioned in only about 10 per cent of the cases in the literature. Especially does this seem to be true in the cases which have been frequently cauterized, the ensuing chronic irritation playing an important part in the malignant degeneration of these tumors. Stricture and chronic urethritis in the female are not generally considered important factors, while trauma and predisposition are given considerable weight by the majority of authors. In the male, O'Neil (25) gives the predisposing causes as trauma, leucoplakia from chronic urethral irritation, and stricture formation, the latter being present in 50 per cent of the cases. He believes that in the majority of instances the lesion arises from the bulbous urethra, and this is certainly the most common site for stricture formation. Rizzi (35) found a traumatic history in only 10 per cent, and a gonorrhœal history in 60 per cent of his cases. He determined the sites most frequently affected to be: cavernous portion 52 per cent, bulbous urethra 25 per cent, and membranous and prostatic portions 22 per cent. Barabino (29) thinks that the most common causes are chronic infections of the urethra and predisposition

The onset is usually insidious, and no symptoms may be experienced until the lesion is well under way. Venot and Parcelier state that when the growth is well established, the symptoms of pain, urinary disturbances, and hæmorrhage are the outstanding features. The pain is usually not intense but radiates into the thigh, pelvis, and vaginal fundus. There is sometimes pain on coitus, especially if there is ulceration. Urinary disturbances are constant and usually are the first to attract the attention of the patient. Frequency, pain on urination, retention, and finally incontinence, complete or partial, make up the picture. A few cases are reported in which the evolution was without urinary disturbances. Hæmaturia, which is stated to be rare, is often thought to be of genital origin by the patient. The general condition is affected

only when the local condition has become very advanced. Objectively the condition may present under any of the three forms given: the polyp or papillary form, the ulcerous, or the infiltrative type. Inspection and palpation serve to disclose the presence of tumor growth, while endoscopic examination, which is less satisfactory and sometimes very difficult, may be of value. The passage of a small sound will serve to accentuate the localization of the tumor to the palpating finger.

In the male, O'Neil (25) states that the early symptoms are not characteristic, and are such as would coincide with ordinary urethral stricture, namely, disturbance of micturition, hæmorrhage, hæmaturia, and a purulent discharge. As the condition advances there may be swelling of the perineum and extravasation of urine. Pain is usually limited to the act of urination, except when the condition has become well advanced, when it may be more or less constant. The general condition is affected in proportion to the advancement of the new-growth. On physical examination the tumor mass is recognized by palpation and inspection, and the use of the endoscope, where possible, may be of value. In the male and female alike, inguinal adenopathy of varying degree is usually found.

The diagnosis is made from the history, physical findings, and biopsy report. In any doubtful case the latter procedure is essential, and in all cases showing a tumor growth about the urethra, the diagnosis should be suspected. In the male it may be necessary to differentiate the condition from stricture with extravasation, or urinary fistula, and without a biopsy this is often impossible. O'Neil states that many cases have been operated upon one or more times before a diagnosis was made. Careful examination together with a histopathological examination should obviate any difficulty in arriving at a correct conclusion.

There are two recognized methods of treatment, operative procedures, and treatment by physical agents such as radium and mesothorium. According to Venot and Parcelier the following figures are obtainable from their collected cases:

Partial resection of the urethra with suture of the urethral extremity to the mucosa of the vestibule or vulva. These authors find 28 such treated cases without any operative deaths, and with a good functional result in the majority of cases, since there was incontinence in only 3. However, there were nine recurrences among this number.

Total resection of the urethra with the establishment of a neovaginal or suprapubic stoma. Vaginal drainage was done in 22 cases, as compared with 8 of the other type. There were two postoperative deaths, 6 and 8 days after the operation, and the functional results are naturally not so good as in the partial resections. In 22 cases, in 12 only was continence mentioned as obtained after the operation; in four there was partial continence, and in the other cases there was rapid recurrence.

Extremely radical operations are reported in two cases. In the first a symphysectomy with excision of the tumor and formation of an artificial urethra was done. In the second case a two-stage operation was done. The first stage consisted of dissection of the vulvar orifice and meatus. In the second stage a median subumbilical laparotomy was done with hysterectomy and ablation of the urethra *en bloc*. The patient died of shock.

Extirpation of involved inguinal glands has been attempted in 10 cases. Four times in 28 partial resections of the urethra, and six times in 30 total resections. In several instances the removal of the glands was carried out as a second stage procedure, being done several months after the removal of the urethra.

Aside from the cases where an extensive operation was done, the surgical treatment of urethral cancer presents an almost completely absent postoperative mortality. In a few cases where a second operation was done against recurrence the result was without avail. Venot and Parcelier give the results after partial resection of the urethra in their collected cases as: one survival after 6 years, one after 3 years, one after 2 years, one after 1½ years, one after 11 months. After total resection: one survival of 10 years, one of 5 years, two of 2 years, one of 20 months, one of 13 months, one of 1 year. Crossen (23) summarized the results in 25 cases operated upon radically and found: eight cures of more than 3 years, three probable cures after 2 years, eight re-

currences, and six unknown results. In the other cases found in the literature the results are: six cases of recovery with continence, six of recovery with incontinence, one recovery with fair continence, four recurrences, two deaths, and three cases with unknown results. In general plastic operations have been successful in but very few cases.

With respect to the use of radium and mesothorium, this method of treatment is the one of choice in inoperable cases, and from the few reported cases where they have been used, they have shown themselves to be of some benefit, especially in the cases of Blumberg, Legueu, and Condamin, collected by Venot and Parcelier, and that of Shoemaker (24). The combined surgical procedure with the use of radium has also been effective in some patients.

In dealing with cases of carcinoma of the male urethra, the same measures have been used with varying degrees of success. Of 10 collected cases by Hall (26) treated by resection or some form of extirpation, the result was unknown in 1, 4 died within 9 months, 1 recurred within 6 months, and in 4 there was no recurrence within 21, 11, 10, and 4 months respectively. Rizzi (35) states that of 25 collected cases radically operated upon there were: 4 primary deaths, 5 recurrences within 6 months, 3 cases cured for 2 years or longer, 13 cases cured for 6 to 10 months. O'Neil believes that early amputation of the penis has given good results where the penile urethra alone was involved.

In operable cases, whether in the male or female, it seems logical to use both surgical measures and radium, or massive doses of X-rays. Just what results might be secured from the use of surgical diathermy combined with the after-use of heavy doses of X-rays is a problem for the future.

The prognosis in these cases apparently depends on the stage which the cancerous condition has reached when the patient presents himself, as well as the degree of associated pathology which may be present. In any event it must be considered grave, for once these tumors have established themselves it appears to be the rule that they evolve very rapidly, and the danger of recurrence following operative procedures is great. Consequently the earlier these cases are seen and diagnosed the better the patient's chances for recovery, provided that recourse is had to the proper surgical procedures followed by the judicious use of X-rays or radium.

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PRIMARY RETROPERITONEAL SARCOMA

Report of Twenty-eight Cases[1]

By CLAYTON F. ANDREWS, M.D., Rochester, Minnesota
Fellow in Surgery, The Mayo Foundation

THE term retroperitoneal sarcoma, originated by Lobstein, usually includes both primary and secondary growths behind the peritoneum. The secondary sarcomata usually originate in the testicle or ovary and are not included in the report of cases of true primary retroperitoneal sarcoma. Growth in the latter type originates behind the peritoneum in the postperitoneal areolar tissue, adipose tissue, or lymph glands, and occasionally in the vertebræ, independently of any organ, such as the kidney or adrenal.

Steele, in 1900, reviewed the literature and reported 96 cases of primary retroperitoneal sarcoma, including 5 of his own. Trout and Meekins, in 1920, reported 12 additional cases, including 2 of their own, and in 1922, I collected 6 cases from the literature, and added 28 proved cases from the Mayo Clinic, a total of 142 cases. Ten cases clinically diagnosed primary retroperitoneal sarcomata are not included in the series since the diagnosis was not proved microscopically. No satisfactory explanation has been made with regard to the cause of these tumors. The largest tumor on record was reported by Bull and weighed 34 pounds after removal. The microscopic diagnosis of this tumor was myxofibrochondrosarcoma. This study is based on 28 proved cases of retroperitoneal sarcoma.

The ages of the 28 patients in the series ranged from two and one-half years to sixty-two years. Twenty-three of the patients were males and five were females. Rarely is more than one tumor found; multiple growths were present in one case of the series (3.5 per cent). Thirteen of the growths (46.4 per cent) were on the left side, 9 (32.1 per cent) on the right, 3 (10.5 per cent) in the pelvis, and 2 (7 per cent) central; 1 (3.5 per cent) occupied both sides of the abdomen.

SYMPTOMS

The symptoms are insidious, indefinite, and varied. The patients observed in the Mayo Clinic had had symptoms for from 2 weeks to 3 years, or an average for 8 months. The onset is usually insidious with indefinite abdominal pain at times colic-like, nausea, vomiting, and gaseous distention. Pain in the lumbar region and in the leg is a common complaint. The attack may simulate that due to gall stones although the pain is less severe and more constant. Steele considers diarrhœa to be an important symptom; Keen's patients suffered mostly from constipation. Fourteen (50 per cent) of the patients in the Mayo Clinic series had normal bowel function, 2 (7 per cent) had diarrhœa, 8 (28 per cent) had constipation, and one had both diarrhœa and constipation. Two patients had œdema; as a rule it begins at the ankle and extends upward. Six (21 per cent) complained of urinary frequency, 1 had dysuria and hæmaturia, and 1 had ascites. Jaundice, which occurs when the common duct is pressed on by the tumor, was not present. Loss of weight is often marked and rapid and usually accompanied by great loss of strength. Nearly one-half the patients had fever, ranging from 99 to 102, during some stage of the disease. Blood counts were available in 24 cases, in 11 (45 per cent) hæmoglobin was below 70 per cent.

The roentgen-ray aided greatly in the diagnosis by ruling out gastro-intestinal tumors. Its use in conjunction with the cystoscope ruled out genito-urinary masses.

The mass, usually deeply placed, may be mobile or immobile, firm or cystic, smooth or irregular, tender to touch or painless. One of the most characteristic findings is the location of the colon resting in a groove on the anterior surface of the tumor. If the mass is laterally placed, it may be impossible to distinguish it from liver, kidney, adrenal, or spleen. If it is low in the pelvis, rectal or vaginal examination may afford the most valuable information.

Unusual retroperitoneal serous cysts which

[1] Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, March, 1922.

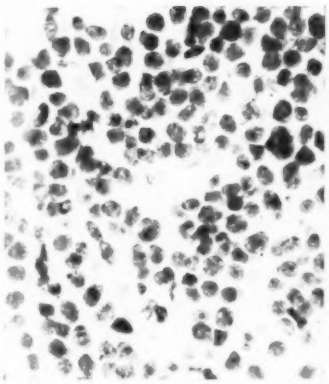

Fig. 1. Lymphosarcoma. (×500.)

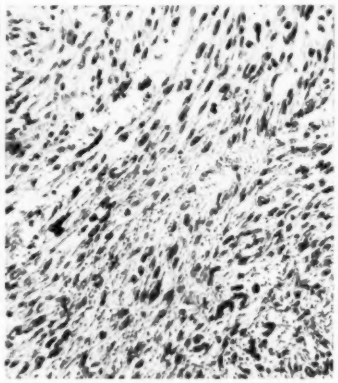

Fig. 2. Spindle-cell sarcoma. (×100.)

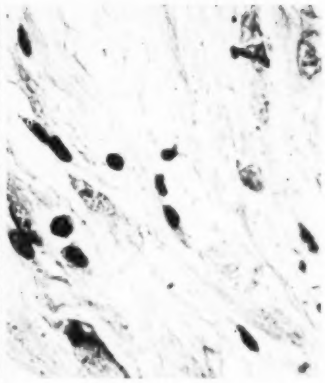

Fig. 3. Fibrosarcoma. (×500.)

may be present may confuse the diagnostician, but these grow slowly and become very large. Aneurysm should readily be distinguished by the pulsation, thrill, or bruit, lack of emaciation and anæmia, and slower growth. Lipomata or myxolipomata grow much more slowly and larger, show marked fluctuation, and cause pressure symptoms much later. Rapid growth in a retroperitoneal lipoma is very apt to mean sarcomatous change. The term, degeneration, is purposely avoided in this connection, as it has been shown that the change from benign to malignant is not one of degeneration, but of very active, though abnormal, generation. Enlarged tuberculous lymph nodes may be distinguished by the history, uniform enlargement of the abdomen, greater emaciation, shorter course, greater tenderness, higher fever, and often by the discovery of tuberculosis elsewhere in the body. It is far more common than is retroperitoneal sarcoma. The most common conditions simulating the growth are ovarian cysts and renal tumors; these can usually be eliminated by careful physical and special examinations.

Metastasis had occurred in about 33 per cent of the series; Steele found practically the same proportion. Metastasis to the liver, lungs, or lymph glands was most common, but the spleen, kidney, skin, omentum, muscle, pleura, heart, bone, spinal cord, dura, adrenal, and mesentery may show secondary nodules.

TYPE OF TUMOR

The most common type of sarcoma in the series was the small round-cell, or lymphosarcoma (Fig. 1) which occurred in 10 of the 28 cases. The next most common was the spindle-cell (Fig. 2) and fibrosarcoma (Fig. 3), each being present in 4 cases. The mixed-cell, fibromyxoma, and myxosarcoma (Figs. 4 and 5) were found in 2 cases each. Small and medium round-cell sarcoma (Fig. 6), myxo-osteochondrosarcoma (Figs. 7 and 8), and giant-cell sarcoma (Fig. 9) were found in one, each; the latter was made up, for the most part, of tumor giant cells.

In the beginning the mass is usually firm and lobulated. Later, it undergoes hæmor-

Fig. 4. Myxosarcoma, 3,900 grams.

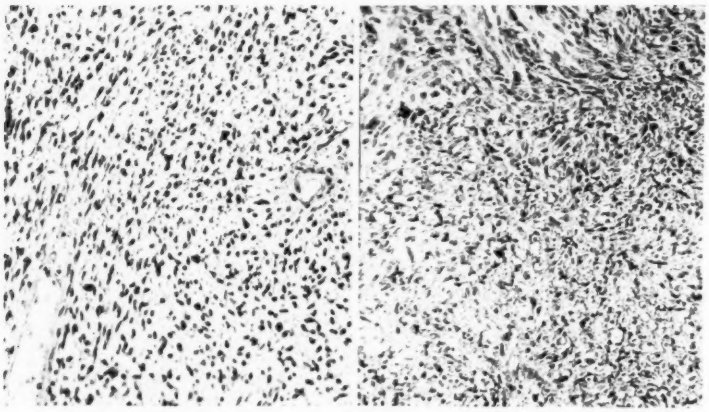

Fig. 5 (at left). Myxosarcoma. (×100.)
Fig. 6. Mixed round-cell and spindle-cell sarcoma. (×100.)

rhagic, mucoid, or purulent degeneration, with the formation of a cyst. On removal, the irregular mass often is found to be encapsulated and quite hard; it may contain lobulated cysts. It offers considerable resistance to cutting, hæmorrhagic areas are not uncommon, and dense whorls of fibrous connective tissue are seen. If it contains muscle it is often salmon-colored; cartilage and bone appear much the same here as elsewhere.

Microscopically, the cells are usually arranged in masses which extend irregularly into strands of more or less dense fibrous tissue. The sarcoma cells are usually associated with abundant capillaries composed of a single layer of endothelial cells. In some instances the blood channels have no endothelium, the blood lying in immediate apposition to the tumor cells. This probably explains the common finding of hæmorrhagic degeneration and metastasis to the lungs and liver by way of the blood stream. The more highly differentiated the cells composing the tumor, the more benign the neoplasm. The most malignant and infiltrative of retroperitoneal sarcomata is the lymphosarcoma, which is the least differentiated. The cells are massed closely, have single deep-staining nucleoli, and contain little cytoplasm; there is very little interstitial connective tissue. In the rapidly growing types, unfortunately the most common types, mitotic figures may be seen.

The medium and large round-cell sarcomata are much less common and also less malignant than the small round-cell type. The cells may be round or oval, the cytoplasm abundant, and the nuclei large. There is more likely to be connective tissue between the cells. Such neoplasms are less destructive and break down more slowly than do the lymphosarcomata.

Large and small spindle-cell sarcomata show the typical elongated, somewhat pointed cells with oval or spindle-shaped nuclei. These cells are arranged in bundles around the capillaries, with quite definite interstitial connective tissue. They are far less malignant than the round-cell sarcomata. It is not uncommon to find a mixture of all these types, as is illustrated in Case 13 of the series. Also the tumors may be combined with various other tissues to form the so-called intermediate types, as illustrated by the osteosarcomata, chondrosarcomata, liposarcomata, myxosarcomata, fibrosarcomata, and so forth. True bone, cartilage, fat, muscle, or fibrous tissue is found in these tumors, with masses of closely packed, rapidly growing, malignant cells.

Giant-cell sarcomata make up only a small part of retroperitoneal tumors. The one giant-cell sarcoma in our series originated, apparently, from the vertebræ, near the bifurcation of the aorta. Giant cells may be present in many sarcomata, but only when they predominate is the tumor termed giant

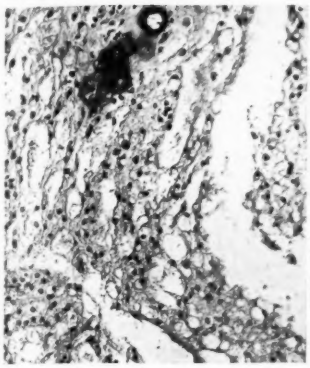

Fig. 7.

Fig. 7. Myxo-osteochondrosarcoma; stellate cells and area of cartilage. (×100.)

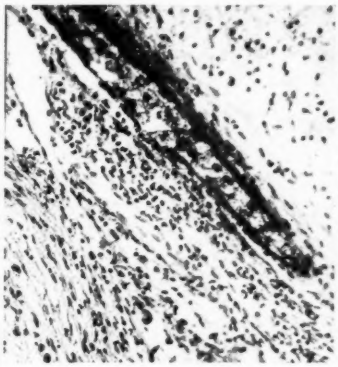

Fig. 8.

Fig. 8. From Figure 7. Area of bone formation. (×100.)

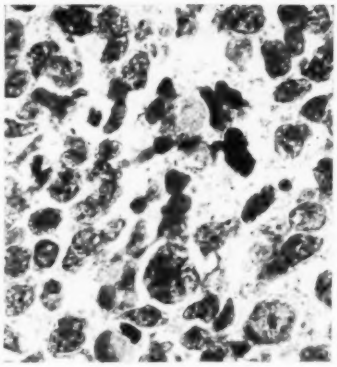

Fig. 9.

Fig. 9. Giant-cell sarcoma. (×500.)

cell sarcoma. These cells are large and contain several nuclei, which tend to arrange themselves together in the middle of the cell. The cytoplasm is opaque and may contain fat vacuoles or erythrocytes. Spindle-cells make up the bulk of these tumors, which are usually very vascular.

TREATMENT

The results of treatment of retroperitoneal sarcomata have been most unsatisfactory, and the prognosis is unfavorable. Potassium iodide has been given internally, but without appreciable benefit. Coley's serum seems to have been of value in many cases as a palliative measure. Surgical removal has been the treatment of choice for years, but it is too often hampered by the location, size, infiltration, vascularity, and adherence to vital structures, preventing complete removal. The condition of 20 of the 27 patients of the series operated on was found inoperable at the time of exploration. Seven tumors were enucleated or removed as thoroughly as possible; the tumor recurred in five instances; one patient died the day after operation; further data from the seventh could not be obtained.

The combination of radium and roentgen-ray treatment afforded excellent results in some of the cases. Several patients with both primary and secondary retroperitoneal sarcomata are now undergoing this type of treatment at the Clinic. The mass has entirely disappeared in several instances; the patients have gained weight and strength, and are able to carry on their work. It is too early to claim permanent cures in such conditions, but even if the great improvement is only temporary, it is well worth while, and achieves more than any previous treatment. If retroperitoneal sarcoma is suspected, a two weeks' course of radium and roentgen-ray will be of great aid as a diagnostic measure. If the tumor is sarcoma, an appreciable diminution in size will be noted. If it is not sarcoma, no damage has been done, and the mass may be explored. In this manner many patients may be saved the pain and expense of a fruitless operation, and receive the benefit of the best treatment now at our command.

SUMMARY

1. Retroperitoneal sarcomata are seen so often that they should be constantly kept in mind in the diagnoses of abdominal disorders.

2. Trauma is apparently not a factor in the cause of retroperitoneal sarcoma.

3. Metastasis occurs in about 33 per cent of cases; it is most often found in the liver and lungs.

4. The most characteristic physical finding is the colon in a groove on the anterior surface of the tumor.

STUDY OF TWENTY-EIGHT CASES OF PRIMARY RETROPERITONEAL SARCOMA AT MAYO CLINIC

Case, date	Sex, age	Duration of symptoms	Date of operation	Findings at operation	Pathological diagnosis	After-course
A36910 4-26-10	M. 40	3 weeks	4-27-10	Retroperitoneal sarcoma, 12 by 12 by 18 cm., originating in inner layer of mesosigmoid	Fibrosarcoma	Death from recurrence October, 1911
A37608 5-14-10	M. 31	5 months	5-21-10	Inoperable, retroperitoneal sarcoma involving lymph nodes	Lymphosarcoma	Death October, 1910
A69466 6-20-12	F. 6	6 months			Giant-cell sarcoma (Fig. 9)	Unknown
A71100 7-25-12	M. 54	Uncertain	8-2-12	Inoperable, retroperitoneal sarcoma at head of pancreas under middle part of duodenum and near hepatic flexure; adherent to liver	Oval and spindle-cell sarcoma	Death February 22, 1914
A99151 1-19-14	M. 19	4 months	1-21-14	Inoperable retroperitoneal tumor in left iliac fossa with erosion of inner surface of ilium	Lymphosarcoma	Death May 19, 1914
A101025 2-21-14	M. 29	3 months	2-25-14	Retroperitoneal sarcoma, 2 by 4 by 9 cm., in region of tail of pancreas	Small and medium round-cell sarcoma	Metastatic nodule behind ear; death from recurrence April 19, 1914
A129170 4-20-15	M. 4	10 months	4-23-15	Inoperable retroperitoneal sarcoma, 15 by 7.5 cm. with metastasis to glands along aorta	Lymphosarcoma (Fig. 1)	Death August 6, 1915
A130262 5-6-15	M. 32	2 weeks	11-12-15	Inoperable sarcoma in lower part of abdomen pushing mesentery of small intestine forward	Small spindle-cell sarcoma	Unknown
A157750 4-23-17	M. 43	1 year	5-4-17	Inoperable retroperitoneal sarcoma in region of right flank	Fibromyxosarcoma	Unknown
A174094 10-2-16	M. 57	1 year	10-6-16	Inoperable tumor filling pelvis and lifting bladder into abdomen and crowding sigmoid behind it	Spindle-cell myxosarcoma	Unknown
A174518 10-5-16	M. 45	2 years	10-17-16	Inoperable retroperitoneal sarcoma extending from diaphragm almost to pelvic brim, displacing large vessels to right, adherent to spleen	Lymphosarcoma	Death November, 1916
A187820 5-9-17	M. 31	3 years	3-24-17	Tumor 20 cm. in diameter growing from sacrum, internal surface of ilium, and ower lumbar vertebræ with metastasis to both lungs	Fibrosarcoma	Death March 25, 1917
A194292	M. 48	10 months	5-21-17	Inoperable retroperitoneal sarcoma with metastatic nodules in the liver	Mixed round-cell and spindle-cell sarcoma (Fig. 6)	Death November, 1917
A197918 6-15-17	M. 62	1 year	6-25-17	Inoperable retroperitoneal sarcoma, 20 cm. in diameter, originating in right iliac fossa and extending upward; dense adhesions to peritoneum	Mixed-cell sarcoma	Death December 25, 1917
A201215 7-17-17	F. 59	5 months	7-24-17	Inoperable retroperitoneal sarcoma attached to bladder and several loops of small intestine and colon	Spindle-cell sarcoma (Fig. 2)	Death December 16, 1917
A227733 4-12-18	F. 32	4½ weeks	4-25-18	Inoperable retroperitoneal sarcoma behind stomach and colon	Lymphosarcoma	Death September 2, 1918
A229340 4-27-18	M. 61	4 weeks	5-4-18	Degenerating retroperitoneal lipoma attached to lower pole of right kidney, weighing 3900 gm., occupying entire right side, and extending to brim of pelvis on left (Fig. 4)	Myxosarcoma (Fig. 5)	Unknown
A230176 5-2-18	M. 57	1 year	5-3-18	Inoperable retroperitoneal tumor, 30 cm. in diameter with broad attachments to all surrounding tissues	Lymphosarcoma	Tumor greatly enlarged; patient has lost greatly in weight and strength
A246653 9-24-18	M. 44	3½ weeks	10-2-18	Inoperable retroperitoneal sarcoma behind cæcum and mesentery of small intestine	Lymphosarcoma	Patient received roentgen-ray for several weeks. In February, 1919, had gained 4 pounds; was without pain and was working
A250614 11-11-18	M. 32	1 year	11-14-18	Retroperitoneal sarcoma attached to right kidney extending from diaphragm to brim of pelvis	Fibrosarcoma	Patient received roentgen-ray, radium, and Coley's serum; January 10, 1919, he had gained 75 pounds and was in good general condition.

STUDY OF TWENTY-EIGHT CASES OF PRIMARY RETROPERITONEAL SARCOMA AT MAYO CLINIC—CONTINUED

Case, date	Sex, age	Duration of symptoms	Date of operation	Findings at operation	Pathological diagnosis	After-course
A25-614 11-11-18	M. 32	1 year	6-13-20	Recurrent retroperitoneal sarcoma, weighing 350 gm., with metastatic nodules in liver and retroperitoneal tissue below the diaphragm.	Fibrosarcoma (Fig. 3)	Death, time uncertain
A251374 11-21-18	M. 42	1 year	12-3-18	Inoperable retroperitoneal sarcoma filling entire right side and extending across median line	Spindle-cell sarcoma	Death a few months later
A275504 6-16-19	F. 2.5	11 months	6-24-19	Inoperable tumor situated retroperitoneally filling entire abdomen	Fibrosarcoma	Death November 13, 1920
A291541 8-1-19	M. 48	1½ months	10-13-19	Two retroperitoneal tumors on left side; one 30 by 15 cm.	Myxofibrolipoma	Patient returned to Clinic August 9, 1921, with palpable mass in abdomen
		6 weeks	8-15-21	Recurrent retroperitoneal tumor 20 cm. in diameter below pole of left kidney	Myxofibrosarcoma	Unknown
A295043 10-30-19	M. 41	10 months	11-5-19	Tumor, 12 cm. in diameter, filled with gelatinous bloody material. The sacrum was honey-combed	Myxochondroosteo-sarcoma (Figs. 7 and 8)	Recurrence July, 1920
A297816 11-24-19	M. 3	6 weeks	12-5-19	A hard tumor, 8 cm. in diameter, behind the bladder in the region of the prostate	Myxosarcoma	Death from recurrence March 18, 1920
A304223 1-26-20	M. 26	3 months	1-31-20	Inoperable tumor almost filling the pelvis adherent to loops of intestine; involvement of inguinal glands	Lymphosarcoma	Patient in good general condition
A319811 6-14-20	F. 39	4 months	6-23-20	Inoperable apparently retroperitoneal tumor behind umbilicus with metastasis to the inguinal glands.	Lymphosarcoma	November 30, 1920, patient was in good general condition
A342361 11-30-20	M. 42	5 months			Lymphosarcoma	January 4, 1921, death from bronchopneumonia. Necropsy revealed retroperitoneal lymphosarcoma with metastasis to the great omentum and mesenteric lymph nodes

5. The small round-cell sarcoma or lymphosarcoma is the most common and most malignant type.

6. The prognosis is always unfavorable. A combination of radium and roentgen-ray seems to be the most satisfactory treatment thus far instituted.

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THE CLINICAL PICTURE OF DILATED DUCTS BENEATH THE NIPPLE FREQUENTLY TO BE PALPATED AS A DOUGHY WORM-LIKE MASS—THE VARICOCELE TUMOR OF THE BREAST

By JOSEPH COLT BLOODGOOD, M.D., F.A.C.S., Baltimore

SURGEONS must quickly learn that the various benign and malignant lesions of the breast are associated with different clinical pictures and that the same pathological process may give rise to different clinical appearances varying from distinctly benign to evidently malignant.

The gross and microscopic pathology of various pathological conditions of the breast has been pretty well established, but in recent literature one can find little help in the interpretation of the varying clinical pictures, and I propose to attempt from time to time to describe them with the hope that these descriptions will be helpful to those responsible for the diagnosis before operation, and during operation when an exploratory incision is indicated.

CLINICAL PICTURE

We cannot expect much help from the older textbooks and monographs, nor even from more recent textbooks and contributions. This is due to the fact that until recently the majority of women feeling a lump in the breast has delayed. During this delay, I have evidence to show that many lumps, especially those due to chronic cystic mastitis, disappear spontaneously. The malignant tumor rapidly assumed the clinical picture of cancer due to the retraction of the nipple, the involvement of the skin, and even ulceration of both, while the distinctly benign remained an encapsulated tumor without changes in the skin or nipple.

Benign lesions of the female breast for which operation is not indicated. In 1922 in a paper with the above title[1] I recorded the fact that in the last 100 women whom I had examined, in over 50 per cent the clinical picture was such that operation was postponed and, in the majority of cases, not performed. Of the remaining 50 per cent more than 25 per cent were benign.

[1] J. Am. M. Ass., 1922, lxxviii, 859.

When we compare these figures with the first decade (to 1900), it was found that in less than 2 per cent was operation not indicated and in about 10 per cent only was the tumor benign.

In December, 1921, I found that I had collected 267 histories of women in which operation was considered not indicated. In 64 of these, as the patient had pain and 14 of them had felt a tumor, careful and often repeated palpation was necessary before the conclusion was made that neither breast contained a lump.

In 50 cases the breast was the seat of multiple indefinite lumps probably due to some form of chronic cystic mastitis, and the absence of a definite lump precluded any operative intervention.

I feel convinced that every member of the medical profession called upon to examine the breast, either from the standpoint of the clinician only, or from the attitude of both clinician and operator, will see more and more of this type of breast lesion and all of them will need some definite data based upon the study of a large group of cases which should be helpful to them in making a decision.

Chronic cystic mastitis. In the *Archives of Surgery* for November, 1921 (iii, 445–542), I described in detail the gross and microscopic pathology of chronic cystic mastitis, and reproduced 91 illustrations, gross and microscopic. This report was based upon the study of 350 cases.

On page 450 of that article the diffuse dilatation of the ducts beneath the nipple is described as follows:

"*BB-13-6. The diffuse dilatation of the ducts chiefly in the nipple zone, rarely in the breast outside this zone.* The characteristic clinical picture when the dilated ducts are situated in the nipple zone is the palpation of a doughy, worm-like mass beneath the

nipple. When explored, one can recognize large and small dilated ducts with distinct wall, containing brown, green, milky, or cream-like material, of various degrees of viscosity and consistency. The contents, when expressed, appear as soft, worm-like masses exposing the distinct smooth wall of the duct—a gross picture, if carefully inspected, different from that of the comedo-adenoma.

"When it occurs in a zone of breast outside the nipple area it feels like diffuse mastitis, but has not the distinct edge or border of the diffuse non-encapsulated cystic adenoma."

On page 500 of the *Archives of Surgery* (loc. cit.) I report in detail a number of these cases of which at that time there were 22, and describe the different clinical pictures.

Even at the time of the writing of this article (July, 1921) I was rather of the opinion that operation was *not* indicated if the tumor beneath the nipple palpated distinctly like a doughy, worm-like mass, and record one observation (page 507) in which operation was not done, and the tumor disappeared. Since then I find records of 7 additional cases in which I have deferred operation and in which the lesion has practically disappeared.

The varying clinical picture associated with diffuse dilatation of the ducts in the nipple zone. This definite pathological entity can be classed as a part of chronic cystic mastitis. It may be present and give no evidence of its presence by either pain, discharge from the nipple, retraction of the nipple, or a palpable tumor. When breasts are removed for benign or malignant tumors situated outside the nipple zone and a section is made through the breast and nipple, one may find beneath the nipple these dilated ducts with their characteristic contents (Fig. 1). In the *Archives of Surgery* (loc. cit.) in describing the excision of a blue-domed cyst I have called attention to the quite common exposure of these dilated ducts beneath the nipple divided when one cuts the breast between the nipple zone and the blue-domed cyst.

I have carefully studied all our cases of cancer of the breast and I am unable to demonstrate any relation between malignancy and the dilatation of the ducts beneath the nipple. For this reason, if there is nothing to be made out but the palpation of a single or multiple worm-like, doughy mass beneath one or both nipples, with or without discharge from the nipple, there is no indication for operation.

Unfortunately this pathological entity—dilatation of the ducts beneath the nipple—may be associated with palpable tumors of a different character from that described as typical and, in addition, there may be retraction or fixation of the nipple, dimpling or fixation of the skin. In some instances the clinical picture so closely resembles cancer that it seems only proper in this group to perform the complete operation for cancer without exploration. In a few instances the re-active mastitis (periductal) is so marked that the tumor beneath the nipple not only has the induration suggestive of malignancy, but when it is explored, cuts and looks like cancer, as the inflammatory tissue has obliterated and emptied the ducts. A few cases have assumed the picture of an abscess beneath the nipple and areola, due to infection of a dilated duct, and in a very few cases the area has been outside the nipple zone, and in these the clinical picture has closely resembled cancer.

The clinical pictures recorded in cases of diffuse dilatation of the ducts situated beneath the nipple (26 cases). I will not describe the pathology as it is pictured in detail, with illustrations in the *Archives of Surgery* (loc. cit.). Fourteen may be classed as clinically benign, 9 as malignant, and in 3 the palpable tumor resembled an abscess.

1. The tumor palpated like a single tortuous worm or a bunch of worms beneath the nipple (the *varicocele* tumor of the breast)—11 cases; 7 unilateral, 4 bilateral. Of the 7 unilateral cases, 2 under observation became bilateral.

2. The tumor palpated somewhat like a cyst beneath the nipple—3 cases, all unilateral.

In these 14 cases there was no evidence suggestive of malignancy. In 9 cases there was a discharge from the nipple, in 3 no discharge; in the remainder there is no note on discharge from the nipple.

3. The tumor palpates like a worm-like mass, but, in addition, there is slight induration suggestive of malignancy (1 case) or a retracted nipple (1 case).

4. The tumor is described as a mass beneath the nipple, and the nipple is either retracted or fixed; the areola either dimpled or fixed. In these 4 cases the operator performed the complete operation without exploratory incision in 3 cases, and after an exploratory incision in one.

5. The palpable tumor is an indefinite area of induration beneath the nipple with slight retraction of the nipple. Here there are two cases, both bilateral.

6. Retraction of the nipple only; no discharge from the nipple, 1 case.

7. The tumor resembles an abscess with the red and infiltrated skin and the small, doughy, fluctuating mass, 3 cases.

8. In this group the tumor is palpated outside the nipple zone, 3 cases. One of these has been previously described in the *Archives of Surgery* (loc. cit., Fig. 19, Path. No. 21192, p. 464).

Description of the clinical picture in detail. As I have had a large experience in discussing the clinical examination and diagnosis of breast lesions, both before audiences of surgeons and physicians and in personal conversation and correspondence, I am convinced that, to convey the message properly, one must give in detail the actual description of what was seen on inspection and what was felt on palpation. Fortunately, I am able in this paper not only to record my own observations, but to give the written description of other operators.

Group 1. The varicocele tumor of the breast. No operation 7 cases.

J.C.B. No. 8898. Observed in 1919. This patient noticed a blue area beneath the areola near the nipple and then thought she felt a little hardening beneath this point. There was no discharge from the nipple. It has been present a few weeks. At my examination I could see a little bluish spot beneath the areola of the right nipple and could palpate a tortuous, doughy, worm-like tumor, perhaps 1 centimeter in length. When the breast was pushed forward there appeared to be slight dimpling in the blue area over the lump. My experience has taught me that slight dimpling in the areola has not the significance of malignancy as when it is present over a lump outside this area. This patient has been observed now (September, 1922) 3 years and 10 months. There was frequently a little pain and tenderness in this lump and it gradually became less distinct. During the interval there were recurrences of pain and tenderness, an increase in the size of the lump, and a similar palpable lesion in the other breast, without discharge from either nipple. The blue area and the palpable lumps have disappeared.

J.C.B. No. 9105. Observed in 1919. The patient had observed a redness of the areola of the left breast 3 weeks ago. It disappeared in 2 days; then she felt an indefinite lump which had distinctly varied in size. I could palpate a number of doughy, worm-like masses; there was no discharge from the nipple. The condition rapidly disappeared, and the patient reported no return after 3½ years.

J.C.B. No. 11987. Dr. J. L. Campbell, of Atlanta, Georgia, made the following report to me in July, 1922: "The patient has observed a brownish discharge from the right nipple for 6 weeks, and some pain in the breast." On palpation, Dr. Campbell writes: "Immediately beneath the areola there is a tortuous, worm-like mass 3 centimeters long and 3 millimeters wide. . . . . Gives a sensation to the fingers as if filled with varicose veins. On pressure there is some bloody discharge from the nipple." There is no report since this first note. I advised against operation.

J.C.B. No. 12004. This patient has observed pain and tenderness in the left breast for 3 years, chiefly before menstruation. Recently the patient thought she felt a lump in the nipple zone, and there is tenderness there. There has been no discharge from the nipple. I could palpate a single, tortuous, doughy, worm-like mass about 1 centimeter in diameter, but could express nothing from the nipple. Operation was not advised, and there has been no report since examination in July, 1922.

J.C.B. 8598. Observed in July, 1918. In this patient the left breast had been operated on for cancer 14 months before. The sections of the tumor sent to me at that time showed no evidence of carcinoma but dilatation of the ducts in the nipple zone with periductal mastitis. The patient was then referred to me, because she had observed a milk-like discharge from the left breast of some 6 months duration. At my examination in July, 1918, I could palpate no tumor, but could express milk-like material from the nipple. Operation was advised against, because of the definite microscopic evidence that the tumor in the right breast was not cancer. The patient returned in 1 year, because she and her physician had felt a lump near the nipple; the discharge had disappeared. At my examination there was an indistinct, single, doughy, worm-like mass 1 centimeter long beneath the nipple, and nothing could be expressed from the nipple. I am informed 3 years later that the tumor has disappeared.

J.C.B. No. 10524. This patient had had pain, tenderness, and a lump beneath right nipple for 4

months. The lump had been felt by her physician, Dr. Wertz, of Hagerstown, Maryland. At my examination I could palpate beneath both nipples the typical varicocele tumor. The patient was unaware of the condition on the left side, and there was no pain or tenderness on the left side, and nothing could be expressed from either nipple. At the second examination 7 weeks later both tumors were less distinct, and the pain and tenderness in the right breast had diminished. It is now more than 1 year since the last examination and as both Dr. Wertz and the patient promised to report I infer that the condition is improving or disappearing.

Pathol. No. 12105. I was asked to see this patient by Dr. R. C. Coffey of Portland, Oregon, in July, 1922. He had accurately described the condition, favored a benign lesion, and advised against operation. The patient had observed a small lump in the area of the areola for 1 year. It has become larger and painful 2 months, and when Dr. Coffey first examined the patient 1 week ago, he could express from the nipple thick, grumous, brownish material which varied in color. At my examination I found what Dr. Coffey had found in the right breast—a soft doughy nodule the size of a ten-cent piece which, when pressed upon, was tender and brownish material came from the nipple. I also found a similar nodule beneath the left nipple, but this was not tender and nothing could be expressed from the nipple. I advised against operation unless, under observation, the tumor did not disappear. It is now 6 weeks, and Dr. Coffey writes that the condition remains the same.

I have, therefore, summarized 7 cases of which 4 at the onset were unilateral and 3 bilateral. Under observation 1 has become bilateral. None were subjected to operation.

CLINICALLY BENIGN TUMORS

Group 1. The varicocele tumor of the breast, clinically benign, subjected to operation—4 cases.

Path. No. 19767. Observed in 1916. The patient had observed a brownish discharge from the right nipple and had felt an indefinite tumor in the nipple area, and there had been pain and tenderness. At that time, although I did not think that the condition was malignant, I removed the breast. For the gross pathological picture see *Archives of Surgery* (loc. cit., Fig. 16, p. 461). There has been no trouble in the remaining breast now, 6 years since the operation. If I had examined this patient recently, I would have advised against operation.

Path. No. 19902. Observed in 1919. This patient had observed pain and tenderness in both breasts for 1 year. The breasts were carefully examined by Dr. Porter, of Roland Park, Maryland, with negative findings 8 months ago. Three days ago she suddenly felt a lump beneath the right nipple; the lump was tender, and she observed a drop of brownish material. At my examination I could palpate beneath the right nipple one small, doughy, worm-like mass, and could express a drop of brownish material. I could palpate nothing in the other breast. Although I considered the condition benign, I explored, found the tumor to be dilated ducts surrounded by other dilated ducts filled with brownish material. I removed the breast, which I would not do today.

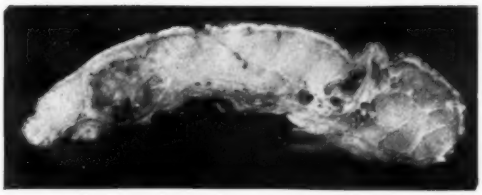


Fig. 1. Gross section through nipple and breast. Beneath nipple great dilatation of ducts filled with greenish-brown grumous material. The cancer tumor in the periphery to the left. In this case there was no palpable tumor in the nipple area and no discharge from the nipple. Path. No. 14924.

It is now 6 years, and no trouble has developed in the remaining breast.

Path. No. 24560. Observed in 1919. This patient was referred to me by Dr. Ries, of Baltimore, because of a milk-like discharge from the right nipple and worm-like masses beneath the nipple. It is interesting to note that the patient ceased nursing a child 7 months ago, and she has observed a lump and a milky discharge since. At my examination the tumor felt like a varicocele. There was no induration or infiltration, no retraction or fixation of the nipple or areola. As the condition did not disappear under observation, 2 months later I explored the zone, found the dilated ducts and for the first time confined the operation to the excision of the affected zone only. The gross pathology is pictured in the *Archives of Surgery* (loc. cit., Fig. 17, p. 462). This patient has now been observed more than 2 years. A few months after operation a similar condition developed beneath the nipple of the other breast which disappeared under observation.

This is the only case in which dilatation of the duct beneath the nipple has had such a close relation to lactation. The contents of the dilated duct was not that of galactocele, and the surrounding breast showed no lactation hypertrophy.

Path. No. 27114. Observed in 1920. It is interesting to note that the lesion in this case had previously been diagnosed Paget's disease, because the discharge from the nipple had produced an irritation.

Fig. 2. Section through nipple and breast. Note dilated duct filled with milk-like material; surrounding breast, fatty and senile. Path. No. 19994.

When I examined the patient this irritation had disappeared. The discharge had been observed 2 months ago; it was yellowish in color and has not been observed recently. I could palpate beneath the left nipple the typical varicocele tumor. The nipple was a little pulled in, but not fixed, and the patient was positive that this slight retraction had been present a number of years since the previous lactation. In this case I explored, found the dilated duct, and removed the affected zone beneath the nipple. The gross pathology is illustrated in the *Archives of Surgery* (loc. cit., Fig. 18, p. 663). No trouble has developed in either breast now, almost 2 years since operation.

Group. 2. The tumor palpates somewhat like a cyst beneath the nipple—3 cases, 2 unilateral and clinically benign.

Path. No. 19994. This patient has had pain in the left breast for seven days and has felt the lump one day. At the examination by me the tumor, the size of a silver dollar, occupies the center of the breast; it has the tenseness and spherical shape of a cyst. The nipple and skin are normal. From the nipple I could express yellow, creamy material. The same material could be expressed from the right nipple, but in this breast I could not palpate a tumor. I was inclined to the view that it was benign, but felt that it should be explored, as medullary carcinoma now and then gives this sensation to palpation. However, if the patient was correct in her statement as to the duration, malignancy could practically be excluded. I have observed blue-domed cysts of this size of 24 hours' duration, but until this case not one due to dilatation of the ducts.

At the operation I explored the tumor in the left breast, and found it to be a cyst filled with thick, cream-like material; the cyst immediately collapsed. All the ducts beneath the nipple were dilated giving the picture of a diffuse galactocele (Fig. 2) (Path. No. 19994, gross). The microscopic picture of the diffuse dilatation of the ducts has been reproduced in the *Archives of Surgery* (loc. cit., Fig. 49, p. 492).

At this time I was not so certain that dilatation of the ducts might not now and then be a precancerous lesion. For this reason I removed the other breast also. Although there was no palpable tumor in this breast, the ducts showed dilatation with thick, cream-like contents.

Relation to galactocele. I have already mentioned one observation in which the dilatation of the ducts filled with milk-like material seemed to date back to a lactation 7 months before. In this case in which the gross appearance was almost identical with that of galactocele, the patient, although married, had had no pregnancies nor miscarriages. The patient is well 6 years after operation.

Path. No. 22575. The specimen from this case was received in the laboratory unopened. The operator had removed the breast only. On palpation there was a cystic lump the size of a fifty-cent piece beneath the nipple which on section proved to be a dilated duct filled with brownish, grumous material surrounded by other dilated ducts.

Path. No. 25186. When this specimen was received in the laboratory, I was informed by Dr. Finney, who had performed the operation, that he had felt a cystic nodule the size of a ten-cent piece beneath a normal nipple and areola. The lump had been observed 2 months, 1 month after trauma. When Dr. Finney explored on the diagnosis of a benign tumor in 1919, he found many dilated ducts filled with thick greenish fluid, and a small cyst with the same contents. Apparently this was the only lesion to be palpated, and demonstrates that beneath the nipple, there may be many dilated ducts filled with material which are not felt and nothing is expressed from the nipple. Figure 3 is a section through the nipple area of the hardened breast. It shows the larger duct and the smaller ducts with their contents. This gross appearance is typical of the condition I am describing. The result in this case has not yet been ascertained.

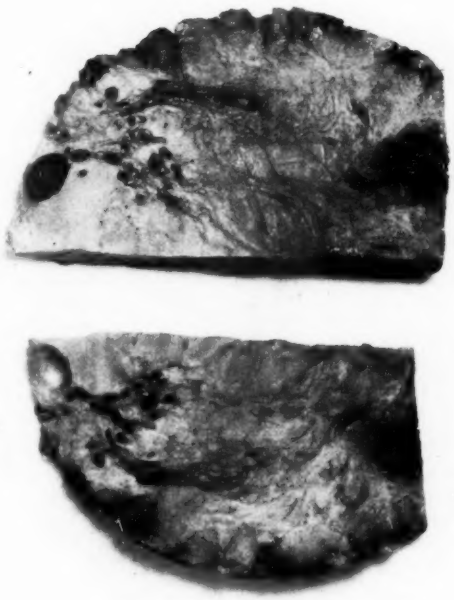


Fig. 3. Section through breast in nipple zone, showing the dilated duct filled with different colored material. Only the larger one to the left was palpable clinically. Path. No. 25186.

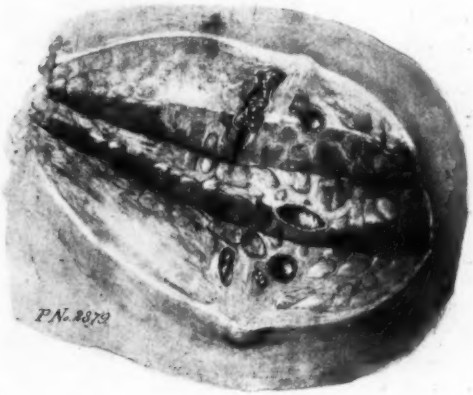


Fig. 4. Photograph of original painting. Note the worm-like mass in the dilated duct near the nipple which could be palpated, and the cyst also to be felt clinically. This is the first picture on record of this type (1899). (From Dr. Halsted's collection.) Path. No. 2879.

CLINICALLY MALIGNANT TUMORS

Group 3. The tumor palpates like a worm-like mass, but there is slight induration suggestive of malignancy, or a retracted nipple (2 cases).

Path. No. 2879. Observed in 1899. I mentioned this case in the *Archives of Surgery* (loc. cit., p. 501) and it represents the first observation of this peculiar worm-like tumor due to dilatation of the ducts. In addition to a doughy, worm-like mass beneath the nipple, there was a second tumor palpating like a cyst, and entirely surrounded by slight infiltration. From the nipple there could be expressed sebaceous-like material. Dr. Halsted, who performed the operation, was inclined to the diagnosis of a benign lesion, and when he explored there was exposed one dilated duct filled with sebaceous material and one small cyst (Fig. 4). Although the operator favored a benign lesion he gave the patient the benefit of the doubt and performed the complete operation. No evidence of malignancy was found in the microscopic section from the breast and the glands. This patient remained well many years.

Path. No. 24633. I described the tumor in this case in 1919 as follows: "The lump beneath the right nipple feels like a varicocele, but there is infiltration of the tissue about it suggesting malignancy. There is no retraction or fixation of the nipple and no discharge from the nipple. When I explored the tumor it looked and cut like cancer, and the complete operation was performed. On examining the breast after operation I found numerous dilated ducts filled with grumous material in a zone beyond that exposed by the exploratory incision. I had exposed at this incision an inflammatory area with marked periductal mastitis which had compressed and almost obliterated the duct. The microscopic section showed no evidence of cancer. This patient has been lost track of.

Group 4. The tumor is described at a mass beneath the nipple, and the nipple is either retracted or fixed (4 cases).

I examined only the specimens in these 4 cases and must therefore give the clinical picture as recorded in the notes sent me with the specimens.

Path. No. 15988. Observed in 1914. Dr. McClure, then the resident surgeon of Johns Hopkins Hospital, performed the complete operation for cancer, because the clinical signs of malignancy were definite. The tumor was an irregular mass the size of an egg beneath the nipple; the nipple and areola were fixed. These must be looked upon as definite signs of cancer. Later, when the tumor was sectioned, it was found to be composed of tortuous dilated ducts filled with greenish, colloid material, with much periductal inflammatory reaction. Microscopic sections showed no evidence of cancer in the breast and glands. The patient was well 6 years later.

Path. No. 25612. Dr. George R. White of Savannah, Georgia, who performed the complete operation in this case described the tumor as "a very hard nodule the size of an English walnut beneath the left nipple; nipple attached but not retracted; creamy-brown discharge from nipple. Other breast normal."

This patient is well 2 years after operation.

Path. No. 28170. My colleague Dr. John M. T. Finney, wrote me about this case as follows: "Woman, age 60; unmarried; pain and small lump 4 weeks. Examination showed breasts small and atrophic; just below the left nipple was a small. rather firm lump the size of a filbert; slight retraction with dimpling of skin was present over this lump; no retraction of the nipple; the lump did not seem to be definitely circumscribed; it was rather elastic. Diagnosis uncertain between a localized area of cystic mastitis and early carcinoma. At the exploratory incision into the lump dilated ducts full of brownish fluid were found; no evidence of cancer. Diagnosis: chronic mastitis." Dr. Finney removed the breast and the axillary glands. The microscopic sections showed no evidence of cancer in the breast and glands.

Path. No. 30842. This specimen was received from Dr. S. W. Budd of Richmond, Virginia, with the following note: "Lump in left breast the size of a duck's egg; hard and infiltrating the surrounding breast. It had been present 4 weeks." The complete operation was performed by Dr. Blair, of Richmond. The gross is described as follows: "In the center of the tumor there is a cavity containing yellowish material. The sections from the tumor and glands show no cancer."

These four cases show that dilatation of the ducts with periductal inflammation may give a clinical picture which cannot be differentiated from cancer.

Group 5. The palpable tumor is an indefinite area of induration beneath the nipple with slight retraction of the nipple (2 cases, both bilateral).

Path. No. 16370. Observed in 1914. This patient consulted me, because she had pain in both breasts. Both nipples had always been congenitally depressed, and for this reason the patient was unable to nurse her children. I describe then in my notes the lumpy breast, or the multiple indefinite lumps in both breasts, as follows: "Both nipples retracted; both breasts lumpy and pendulous; indurated areas chiefly beneath the nipples; sufficiently suspicious to justify the removal of both breasts." Apparently I was impressed with the induration in the breasts beneath the nipple and the retraction of the nipple more than could be explained by congenital depression. I removed both breasts, and found only the dilatation of the ducts beneath the nipples, not very marked, and throughout the breasts minute cysts and adenomatous areas. I am inclined to the opinion that if I were to examine this patient today, I would be able to conclude that she simply had lumpy breasts due a chronic, diffuse cystic mastitis, and that the nipples were of the congenitally depressed type; that operation was not indicated. The microscopic study showed no evidence of cancer. The patient died 4 years later from influenzal-pneumonia during the epidemic.

Path. No. 19824. Observed in 1916. This patient first observed serum from the left nipple 11 months before examination, and there continued to be a discharge, watery and bloody. My note on the examination in 1916 reads as follows: "On pressure bloody serum from the left nipple; nothing to be expressed from the right nipple. Both breasts are lumpy; both nipples dimpled when the breasts are pushed forward. Definite induration in the nipple zone of the breasts; the nipples seem a little thick. The patient is 72 years of age. I removed both breasts.

I am inclined to think should I examine this patient now, I would place her record in the group of discharge from the nipple and bilateral lumpy breasts, and advise against operation. I have never seen carcinoma to begin simultaneously in both breasts. Discharge from the nipple is rare in carcinoma. The probabilities are that I exaggerated the induration beneath the nipple.

Group 6, there is retraction of the nipple (1 case).

Path. No. 14135. Observed in 1913. This patient age 65, had observed pulling in of the nipple for 10 months. Nothing was to be made out on examination, except a distinctly and completely retracted nipple. I removed the breast and found nothing but a few dilated ducts beneath the nipple. This patient died of other causes 1 year later.

Group 7 shows clinically an abscess.

Path. No. 20117. Observed in 1916. Dr. Dandy, then resident surgeon of Johns Hopkins Hospital, asked me to see this patient, and we made the diagnosis of mastitis in diffuse dilatation of the ducts beneath nipple. The breast was removed. On examination, both breasts were large and pendulous. In the right breast beneath the nipple there were two doughy, worm-like masses. The skin of the left areola and a small zone beyond was red and indurated—the picture of mastitis—and beneath the nipple and areola a doughy mass. There was no discharge from the nipple. The patient, age 48, had observed trouble in the left breast for 1 year. There has been redness and pain, and what she described as pimples on the areola. The present attack which was more marked than any previous be-

gan three days ago. The gross pathology showed dilated ducts beneath the nipple with periductal mastitis and a small abscess. The microscopic sections showed no evidence of cancer. There maining breast has given no trouble in the 6 years since operation.

The clinical picture here is distinctly that of an inflammatory lesion. Cancer never assumes such a picture in the first few days. The proper treatment today would be ice, incision if the inflammatory process did not subside, and if there was healing without residual induration, further operation would not be indicated.

Path. No. 27935. The history and tissue was sent to me by Dr. Loos of Bay City, Texas, in 1921, and I have reported this observation, with illustrations in the *Archives of Surgery* (loc. cit., Fig. 20, p. 405). Dr. Loos describes the onset of the trouble 3 weeks before his examination, as an acute swelling of the breast with pain. These symptoms disappeared in 1 week, and recurred. On examination Dr. Loos describes the mass as of the size of a silver dollar in the nipple zone; the skin was red; the mass fluctuated; pus could be expressed from the nipple; the glands in the axilla were palpable; the nipple seemed slightly retracted. Although the operator was inclined to the diagnosis of mastitis, he considered it safer to perform the complete operation for cancer. On examining the breast after operation his conclusion was that the lesion was mastitis and not cancer. Microscopic sections of the tumor and glands show no cancer. The patient has remained well more than 1 year since the operation.

Path. No. 28669. This breast was sent to the laboratory with the clinical and gross diagnosis of tuberculosis. At the examination of the breast before operation, it was noted that there was a small mass of induration beneath the nipple and that the skin was red. The patient, age 28, unmarried, had observed a lump near the nipple for 2 years. The pain and redness were recent. The microscopic sections show no evidence of tuberculosis; there are dilated ducts and periductal mastitis, and a small abscess.

Group 8. Tumor outside the nipple area (3 cases).

Path. No. 21192. Observed in 1917. I have described this unique case in the *Archives of Surgery* (loc. cit., Fig. 19). The picture was one of diffuse mastitis involving the outer hemisphere; acute in onset with pain and swelling of 10 days' duration.

In the *Boston Medical and Surgical Journal*, August 17, 1922, clxxxvii, p. 243, I described breast lesions which have the clinical picture of a diffuse mastitis. The pathological processes which may give rise to a diffuse infiltration of a zone, hemisphere, or the entire breast may be lactation mastitis, non-lactation mastitis, diffuse dilatation of the ducts with periductal mastitis, tubercular mastitis, diffuse chronic cystic mastitis (the "shotty" breast), comedo-adenoma with and without cancer, and carcinoma mastitis. In addition to what has been published in the *Boston Medical and Surgical Journal*, there appears in the *Southern Medical Journal* for December, 1922, a contribution to diffuse mastitis of the breast, and its recognition and treatment.

Of the two remaining cases in this group I have the specimens and short clinical descriptions.

Path. No. 13864. Observed by Dr. Egdahl in 1916. He writes that the lump in the breast is in the upper quadrant; the nipple is distinctly retracted and fixed. Naturally, he did the complete operation for cancer. The patient is well 8 years later. The gross and microscopic study showed that in the tumor area there were chiefly dilated ducts which were also present beneath the nipple.

Path. No. 23024. This specimen was sent to the laboratory by Dr. Barrett, of Baltimore, in 1918, with the information that the complete operation had been performed, because of a tumor in the upper and outer quadrant of the breast the size of a ten-cent piece over which the skin was adherent and dimpled. In the specimen we found in the tumor area a dilated duct filled with brown, grumous material. Beneath the nipple the duct was slightly dilated. The sections showed no evidence of cancer. This patient is reported well 2 years later.

ETIOLOGY

Relation of chronic dilatation of the ducts to age, lactation, and menopause. Like any type of chronic cystic mastitis, this lesion has been observed throughout adult life. On the whole this type of dilatation of the ducts is more common after the age of 45, and the patients are usually at the menopause, or have passed it. It has been observed in women who had never borne children, and in those who had lactated once or more without trouble. It impresses me as a lesion of the senile breast. *Trauma* is not prominent as an etiological factor.

As a rule the patients come quickly after the onset because of *pain* and *tenderness*, or discharge from the nipple. It may have an acute onset which may subside leaving only

the palpable worm-like tumor, or go on to abscess formation.

The most important point in its recognition is the palpation of one or more doughy, worm-like masses beneath the nipple. I think it may be correctly called the varicocele tumor of the breast.

This evidence seems to show that when the lesion can be recognized, operation is not indicated. When, however, there is a definite picture suggestive of malignancy, either one must explore or perform the complete operation for cancer without exploration.

DISCHARGE FROM THE NIPPLE

Dr. Clarence Cohn has gone over the record of every breast lesion in the laboratory to ascertain the significance of discharge from the nipple, and the following statement may be made from this evidence, some of which has previously been published:

A discharge from the nipple is, of itself, not an indication of a malignant tumor, and if palpation finds no tumor, operation is not indicated. We have records of 36 such cases.[1]

The discharge from the nipple is most frequently observed with the benign tumor—the cyst with intracystic papilloma. It is next most frequently observed in the dilatation of the ducts beneath the nipple. In less than 1 per cent of the cases has discharge from the nipple been the symptom of onset in a breast in which later a cancer developed.

When the discharge from the nipple has been bloody or serous, one usually finds that the tumor associated with it is an intracystic papilloma. When the discharge is thick, grumous, brown, green or yellow, one invariably finds dilatation of the ducts beneath the nipple without an intracystic papilloma.

As dilatation of the ducts with and without a papilloma containing almost any kind of secretion may be present in any breast without any clinical evidence of its presence, it would be natural to find a history of such a discharge or its presence at examination, in every type of breast lesion, whether benign or malignant, and this has been proved to be true. When these breasts are completely sectioned, we rarely fail to find the dilated duct, with or without papilloma.

Therefore, the diagnosis of a palpable tumor associated with a discharge from the nipple, must not be influenced much by this discharge. Yet, when the tumor is a worm-like mass beneath the nipple, it is very suggestive that the tumor is a benign dilatation of the duct. Again, when the tumor palpates like a cyst and, on pressing the tumor, blood or serum exudes from the nipple, this is very suggestive that the tumor is a benign intracystic papilloma.

PAGET'S DISEASE AND DISCHARGE FROM THE NIPPLE

As I have had two patients with discharge from the nipple which produced a slight eczema, and for this reason were diagnosed Paget's disease, I take this opportunity to emphasize again[2] that in Paget's disease there is no discharge from the nipple ducts; there may be weeping, even blood-tinged, after the ulceration has begun. But nothing can be expressed from the nipple.

CONCLUSIONS

In a series of articles I am attempting to describe the clinical picture of the breast lesions, especially those which are pretty typical of the pathological process.

In the *Archives of Surgery* (loc. cit.) and again in the *Journal of the American Medical Association* (loc. cit.), I called attention to the frequency of the multiple indefinite lumps in both breasts. This can be called the "lumpy" breast. When such lumpy breasts are unnecessarily removed, we find that each little area which had been palpated as an indefinite lump is due to increased adenomatous areas, or to one or more minute cysts, or dilated ducts. Operation is not indicated when palpation reveals a lumpy breast only. Then, both breasts may be filled with many definite cyst-like tumors. I am inclined to the view that Warren's term "cobblestone breast" is descriptive. When these breasts are unnecessarily removed the multiple tumors are usually found to be blue-domed cysts.

[1] J. Am. M. Ass., 1922, lxxviii, 859.

[2] Boston M. & S. J., 1922, clxxxvii, 244.

When a zone, or a quadrant, or a hemisphere, or the entire breast, is diffusely thickened, like the caked breast of mastitis, and the involved area has a distinct edge like the liver, and when it is picked up like a saucer from the chest wall and one can palpate numerous shot-like masses, we have a definite clinical picture which may be called a "shotty breast," and in my experience up to date, such a clinical picture has always been associated with the diffuse, chronic, cystic mastitis described in the *Archives of Surgery* under the Group BB-13-8, and is again discussed in the *Southern Medical Journal* (December, 1922).

When the diffuse area does not palpate like a shotty breast, but simply like the caked breast of mastitis, we can use the term *diffuse mastitis* and, as already has been mentioned, it may be either benign or malignant.

Then we have the distinct clinical entity which I have described in this paper, the *varicocele tumor* of the breast. Other types may be evolved as these investigations go on.

PSEUDOHERMAPHRODISM OR COMPLETE HYPOSPADIAS[1]

By FRANCIS R. HAGNER, M.D., F.A.C.S., Washington
Professor Genito-Urinary Surgery, George Washington University; Attending Genito Urinary Surgeon, George Washington University Hospital; Attending Genito-Urinary Surgeon, Garfield Memorial Hospital
AND
H. B. KNEALE, M.D., Washington
Resident Physician, Garfield Memorial Hospital

COMPLETE HYPOSPADIAS

COMPARED with lesser degrees of hypospadias, hypospadias perinealis is by far the rarest form. Up to 1917 Carl Beck, who has seen many cases of hypospadias, had observed only one case of the complete form and this patient disappeared without operation.

In this severe form the scrotum is bifid. The testicles may or may not have descended and are often small. The penis is poorly developed, usually bent vertically, imperforate, and of no physiological use in its malformed condition. It is often mistaken for an enlarged clitoris which is concealed by the scrotal tissues and may resemble the labia majora. The urethral opening is nothing more than an orifice or a gutter in the perineum, lined with mucous membrane.

Mareto and Carpentier have discussed at length the etiology, pathology, symptomatology, and treatment of the perineal form of hypospadias. Parkham in the January, 1901, number of *New Orleans Medical and Surgical Journal* summarized the literature to date, which, as a whole, does not encourage operation for the deformity. He has also described and illustrated the various operations. He has the following to say concerning complete hypospadias. In the fourth form the deformity reaches its extreme degree, the scrotum being divided into two halves, looking so like a labia majora as to deceive one without careful examination. "Tillaux, in his lectures (*Leçons de Clinique Chirurgicale*, 1895, p. 367), tells how he came near making a serious mistake of this kind. The urethra opens at the bottom of this fissure. It might well be denominated false hypospadias.

"In this variety coitus is impossible; indeed, the more pronounced the erection the more the organ is bent forward. Fecundation, of course, therefore, is out of the realm of possibility. Micturition is retromingent and necessitates a squatting position to void soiling the clothing. Such a sufferer can, indeed, bless the hand that reconstitutes him a man."

The operations that are applicable to perineal hypospadias are all based on one of the following principles:

1. Formation of a new urethra by the use of flaps as advocated by DuPlay, Szymanowski, Russell, Angier, and others.

[1] Read before American Association of Genito-Urinary Surgeons

SUMMARY OF CASES OPERATED UPON FOR HYPOSPADIAS PERINEALIS FOUND IN AVAILABLE LITERATURE

Author	Patient's Age	Method	Drainage	Result
Brown and Ishmael		Tunnelization and insertion of catheter, constantly worn until mucous lining formed. Later worn for several hours daily to prevent contraction. Closure of perineal fistula	Not stated	Good. Wife became pregnant
DuPlay		Straightening of penis. Formation of urethra with lateral flaps, sutured over catheter, 6 months later. Closure of fistula	Perineal	Good
Lewis		Scrotal flaps	Not stated	Fair. Bending
Lutaud		DuPlay's method (three stages)	Perineal	Good
Luecke	20	DuPlay's method	Perineal	Excellent
Waltz	9	DuPlay's method	Perineal	Good. Several operations had to be performed to close persistent fistula.
Karewski		Formation of urethra with lateral flaps	Perineal	Fair. Penis buried in scrotum.
Peple	13	Straightening of penis. Formation of urethra with lateral flaps. Closure of perineal meatus	Not stated	Good
Pousson		DuPlay's method	Perineal	Good
Walther	13	Formation of urethra from grafts from thigh, and tunnelization. Nové-Josserand method	Not stated	Good
Pousson	33	Formation of urethra with penile and preputial flaps	Not stated	Good
Montegnacco	7	DuPlay's method	Perineal	Good
Russell	9	Russell's method "Clergyman's stole" flap	Suprapubic	Good. Small fistula in middle third of penile urethra which could be closed by traction on penis and thereby prevent leakage.
Mayo, C. H.	6	Tunnelization. Formation of urethra with flap from prepuce and skin of dorsum of penis on pedicle. Joining of urethræ. Closure of fistula if necessary	Perineal	Good
Martin	12	Straightening of penis and perineal longitudinal division of corpora cavernosa. Covering raw area with Thiersch graft. After graft took, edges of graft were freed and sutured over catheter, forming urethra. Lateral flaps covered over newly formed urethra		Not stated
Curtis	10	Straightening of penis (1897). Formation of urethra with flaps. (Szymanowski method)	Perineal	Good. Fistula persisted for a time but finally closed.
Woolsey	50	Formation of urethra with flaps. (Szymanowski method)	Not stated	Good
Nové-Josserand	15	Tunnelization. Formation of urethra with graft thigh	Perineal	Good. Temporary fistula
Nové-Josserand	6	Above method	Perineal	Fair. No erections
Marion		DuPlay's method	Suprapubic	Good
Nové-Josserand	15	Tunnelization. Formation of urethra with flaps from perineum	Perineal	Good
Russell	8	Russell's method	Suprapubic	Fair. Two fistulæ occurred in penile urethra
Thompson	7	Russell's method	Suprapubic	Opening in middle part of penile urethra after two unsuccessful attempts at closure. Failure due to erections
Tissot	6	DuPlay's method	Perineal	Good

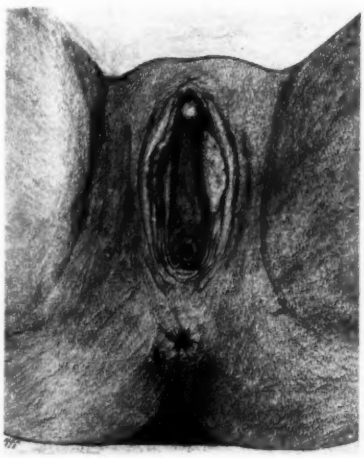


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Condition present before operation.
Fig. 2. View of patient following dissecting of penis before plastic operation on the urethra.
Fig. 3. View of patient following dissecting of penis before the plastic operation on the urethra.

2. Formation of a new urethra by tunnelling and the use of skin grafts according to the method of Nové-Josserand.

3. Formation of a new urethra by transplanting flaps on a pedicle from the prepuce and skin of the dorsum of the penis according to the method of Mayo.

The operation of DuPlay and Nové-Josserand are well described and illustrated in Cabot's *Modern Urology*.

Two procedures are essential to all methods, namely, straightening of the penis and preliminary drainage through the perineal fistula or suprapubic cystostomy, before the formation of the new urethra. A period of several months should intervene between the time of straightening the penis and the plastic reconstruction of the urethra to allow for any subsequent cicatrization.

The age of the patient is an important factor. Some surgeons advocate early operation, but the consensus of opinion favors surgical intervention between the sixth and ninth years when the operator can gain the co-operation of the patient.

In reviewing available literature at the Surgeon General's Library twenty-five cases of complete hypospadias have been found which have been subjected to operation. As a whole the recorded results have been good. Undesirable results have been:

1. Postoperative fistulæ along the course of the newly formed urethra in six cases, the majority of which finally closed;

2. Incurvation of the penis on erection in one case;

3. Failure of erection in one case;

4. Bending forward of the penis on erection in one case.

The almost uniformly satisfactory results obtained in the cases reviewed are probably misleading when all the cases of perineal hypospadias are considered, as undoubtedly more unsuccessful operative attempts have been made that have not been reported than successful operations that have been reported.

This patient was first brought to me in 1908 when he was 2 years old. Family history negative for any deformity in either paternal or maternal ancestors. When the child was born it was first thought to be a girl by the attending physician, but later it was discovered that some abnormality of the sexual organs was present.

At the time of my examination he was a well-nourished, wholesome-looking baby. On inspection of the genital organs there was every appearance of a female child with a large clitoris, the urethral opening having the appearance of a small vagina, neither testicle was down nor could they be palpated in the inguinal canal. The folds on each side gave

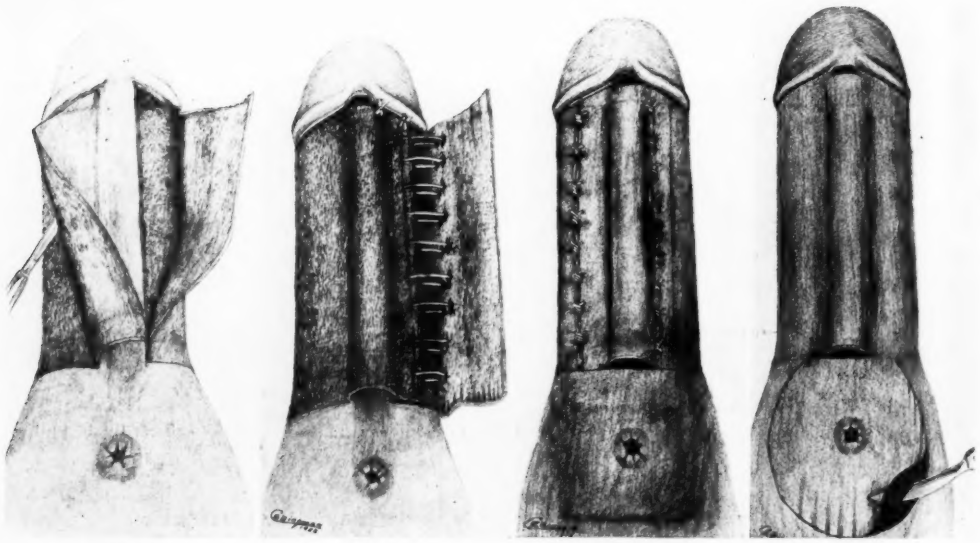


Fig. 4. Fig. 5. Fig. 6. Fig. 7.

Fig. 4. Cutting flaps for formation of pendulous urethra.
Fig. 5. Flap in place. Silver wire passing through outside flap so as to facilitate removal.
Fig. 6. Completion of pendulous urethra.
Fig. 7. Incision to form bulbous urethra.

the typical appearance of a vulva, as shown in the drawing.

On close inspection of the clitoris-like glans, it was noted that the whole penis was covered with tissue except the glans, it, being firmly bound down and immobile. There was no attempt at a formation of a bulbous urethra, the opening in the perineum leading to the bladder which was easily catheterized as it was the beginning of the membranous urethra.

I saw this child at regular intervals until he was 9 years old. At this time I dissected the glans and corpora cavernosa from its surrounding tissues which so firmly bound it down as to make it immobile. A plastic operation was done to cover the top of the penis with skin and the bed from which it had been removed. This healed readily. There was no infection from the urine which escaped from the urethra located well down in the perineum. As soon as the wound had healed I had the mother every day take hold of the organ and make traction upward and forward to give it length and to overcome any tendency of curvature. As the penis was very miserable looking at this time I cannot help but feel that the traction had a great bearing on the ultimate result in this case, and it is a feature that has not been brought out in the cases previously reported. Treatment was continued until 1917. At this time the penis had grown considerably, both in length and size. His left testicle had been down for over a year. It was normal and well formed. Examination failed to elicit any evidence of the presence of a testicle on the right side. As the boy was now 11 years old and was perfectly willing to help in every way, it was decided to begin the building of a urethra.

There was no mucous membrane to work with as there was no vestige of mucous membrane on the under surface of the penis as is seen in cases of penile hypospadias; the under surface of the organ was perfectly flat with no sulcus at any point.

The accompanying photographs taken at this time show the condition presented at the time of operation, but the penis, while it appears in the pictures to have incurvation (on account of the continued stretching referred to before) was more apparent than real.

In collecting literature of cases operated on for complete hypospadias, we find that hardly any two have been operated upon in exactly the same way. This is probably due to the different conditions existing in different cases. The one that appealed to Dr. Fuller and to me was an operation borrowed from the surgeons who operate on cleft palate, the idea being to form a large urethra that would not contract and would not have to be dilated to prevent its closure. (Our patient at the present time has a made urethra that

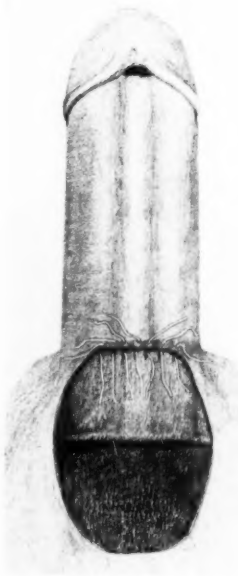


Fig. 8.

Fig. 8. First step in suturing flap to form bulbous urethra.

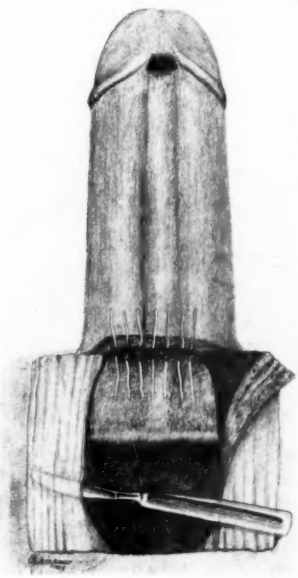


Fig. 9.

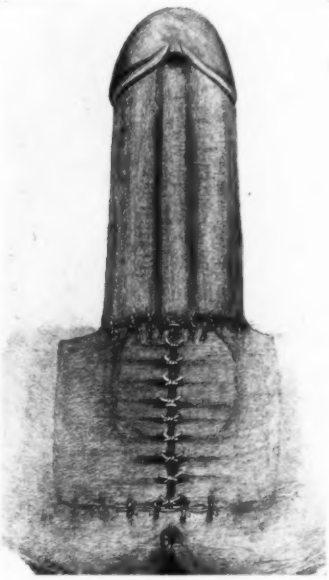


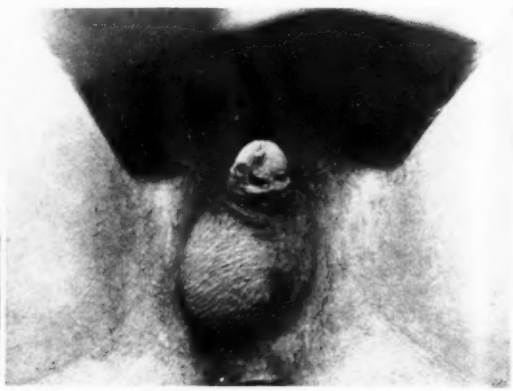
Fig. 10.

Fig. 9. Cutting of lateral flap to form bulbous urethra.
Fig. 10. Completion of suture to form bulbous urethra.

will admit over a No. 30 sound to the bulbomembranous juncture.) Furthermore, we were anxious to have no pulling or shortening of the urethra to cause a tendency to incurvation.

The first operation was performed in February, 1917, and consisted in an attempt to make a floor for the urethra from just behind the glans to 2 centimeters of the urethral opening in the perineum. This opening of the urethra was the entrance to the membranous urethra as indicated before.

An incision was made well over on the left side of the penis and carried back the whole side of the organ and the perineum down to within 2 centimeters of the urethral opening. The flap was dissected toward the median line to a point almost to the apex of the urethra. At each end of the longitudinal incision, necessary right angle incisions were made to permit the flap to fold over. The width of this flap was over 2 centimeters. Another longitudinal incision of equal length was made just to the right of the median line of the under surface of the penis, the flaps containing the skin and subcutaneous tissue. This flap was freed from the median line to the right, a distance to correspond with that on the left, right angle incisions being made at each end to correspond to the width of the flap. The left hand flap was folded over a silver tube that extended from the glans posterior to 2 centimeters from the perineal opening of the membranous urethra, and sutured with fine silver wire to the body of the penis, the silver wire passing through the skin of the left hand flap at its fixed border. After these sutures were placed they were twisted over small strips of gauze to prevent cutting the skin by the wire. This procedure made the inside of the urethra of skin. The freed right hand flap was brought over the raw surface of the left hand flap which formed the urethra, and sutured with silver wire at the margin where the left hand flap had been cut. This procedure made a skin covering so no granulation tissue was exposed. The ends of the new urethra were then sutured by interrupted fine silver wire and this was covered by silver foil and a small de Pezzer



Figs. 11 and 12. Ultimate result after operation.

catheter introduced through the urethra for drainage. This healed perfectly except at one or two points where sutures pulled out, the edges having to be freshened and resutured later. At completion of healing the perineal drainage was removed.

The result of this operation was that the patient had a patulous urethra of skin extending from the glans to 2 centimeters anterior to the perineal opening.

On June 4, 1917, 4 months later, an attempt was made to make a bulbous urethra and attach it to the penile urethra. A suprapubic cystostomy was done for drainage.

An elliptical incision, beginning at the sides of the new made urethra, was carried posteriorly around the opening of the posterior urethra almost to the anus and finished at the opening of the urethra on the opposite side. This was freed so that the posterior portion of the flap could be brought over to meet the new formed urethra. Lateral incisions were then made, freeing the skin over the perineum so it could be drawn to cover the raw surface of the flap that formed the bulbous urethra. Silver wire sutures were used in the same manner as in the repair of the penile urethra coming through the skin covering so they could be removed.

The edges of the posterior end of the newly made penile urethra were freshened, the surface denuded of skin, so as to insure healing of the flaps forming the bulbous urethra, at the points of juncture—silver wire sutures were used and were so placed that all could be removed. This was covered with silver foil and dressings applied. There was never any breaking down at this point. The suprapubic tube was removed in 2 weeks, and a week later the patient was voiding through the new urethra.

At this time I started to make an anastomosis between the anterior end of the urethra and the glans, an opening being made in the glans and a flap of skin being brought through and sutured, with the idea of later making this anastomosis, but as the boy had a useful penis both for urinating and copulating with no incurvation on erection, we felt it best to let well enough alone as we feared this might lead to incurvation and would necessitate frequent dilatation to keep the opening in the glans from closing.

His present condition is as follows: He voids a good full stream perfectly, the only abnormality being that he has to shake the organ to prevent any dropping of urine on his clothes. This is probably caused by our inability to produce the normal elasticity of the pendulous urethra. A No. 30 sound can be readily passed to the bulbomembranous juncture and a No. 20 sound into the bladder. His erections are normal without incurvation.

The results in this case are due to the following conditions:

1. The patient was seen early;
2. The penis was freed and stretched;

3. Too much was not attempted at one time, but the parts were allowed to become adjusted between operations;

4. Large flaps were used thus avoiding tension and the placing of the sutures so no two rows were in the same plane;

5. Drainage through the made urethra was not attempted;

6. The repair operation on the urethra was postponed until the child was old enough to understand the importance of following directions.

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THE COMPLICATION OF PURPURA WITH GESTATION[1]

By GEORGE CLARK MOSHER, M.D., F.A.C.S., Kansas City, Missouri

PURPURA hæmorrhagica is a rare complication of pregnancy. In the literature are 39 cases which have been reported. There is, of course, no method of estimating the number which may have been actually encountered and not recorded. Apparently multiparæ are the more frequently affected, as published observations show that 28 cases were found among women between the second and fifth pregnancies, against five primiparæ and 6 cases after the fifth gestation.

As to age incidence, purpura occurred twenty-two times between the ages of 22 and 35, six times under 22 and eleven times above 35 years.

Purpura seldom appears throughout the gestation; however, there is a marked predominance between the sixth and seventh months. One notes that in 22 cases it appeared before the eighth month, in 12 before the sixth month, and in 5 cases after the eighth month.

It is surprising how little the general condition of the patient in some cases is modified by purpura hæmorrhagica. Often in the most alarming there may be no systematic disturbance whatever, although marked anæmia and a state of asthenia may develop as a result of the continued loss of blood. With this may occur gastro-intestinal upset, thready pulse, and fever. There is often œdema and a trace of albumin in the urine.

Stephen Mackenzie has divided purpura into autotoxic, vascular, mechanical, and neurotic. Doubtless in pregnancy we have a combination of the vascular and toxic groups with a neurotic influence. The case of hæmorrhagic diathesis reported subsequently in this paper belongs, it is believed, to the group described first by Denys and Hayem, and since then has been studied carefully by Bensaude and Rivet, Pratt, Duke, and others.

Duke reported a series in 1910, in which he attempted to prove that both hæmorrhage and purpura in one type of case could be attributed entirely to an almost complete absence of blood platelets, and in doing this found, after study of normal individuals and patients with numerous diseases, that this type of hæmorrhagic diathesis had invariably a reduced platelet count whenever they had a tendency to bleed. The tendency to bleed was studied by means of the bleeding time—not the coagulation time. This was prolonged in both human subjects and in experimental animals whenever the platelet count was reduced to a certain level (10,000), and this was associated in humans with bleeding from mucous membranes and ecchymoses. In one case, in which the count was reduced below 3000, the patient bled from scratches, pin pricks, minute injuries made on the gums by the chewing of rough food, from acne pustules, hang nails; in fact from any abrasion whatever, either of the skin or tissue. He also found that the condition could be relieved immediately by direct transfusion of blood, which operation caused instant increase in the platelet count. The platelets were found to be short lived, under these circumstances, and disappeared in from 3 to 5 days, at which time the hæmorrhagic diathesis, in all its glory, returned. Hæmorrhagic diathesis was relieved, in some of his cases, by a spontaneous increase in the platelet count. He felt, from a study of a series of cases in 1912, that one group of hæmorrhagic cases could be separated from a variety of other types by a clinical picture which was characterized in every instance, first, by a tendency to bleed into the skin and tissues, and from every abrasion, no matter how made; second, by an enormously reduced platelet count—from one thousand to fifty thousand; third, by a normal coagulation time; fourth, by a prolonged bleeding time —10 minutes to 1½ hours (the normal bleeding time is less than 3 minutes), and, fifth, by a non-retractile blood clot. These cases were analogous, he thought, to those described by Denys, Hayem, Pratt, and others.

This disease was found to be of varying etiology. It was noted complicating diphtheria,

[1]Read before the Chicago Gynecological Society, December 5, 1922. (For discussion see p. 583.)

tuberculosis, nephritis, aplastic anæmia. Similar illnesses were reported in the literature complicating lymphocytic leucæmia, hæmorrhagic small pox, typhoid fever, and pneumonia. The case which is to be reported subsequently was similar to these, it is believed, and occurred as a complication of pregnancy.

In a series of thirty-eight animal experiments in which benzol, diphtheria toxin, and tuberculin were injected into animals, in only those in which the platelet count was markedly reduced was there any abnormal tendency to bleed. In one animal treated with diphtheria toxin, typical purpura hæmorrhagica with a very low platelet count, non-retractile clot, and prolonged bleeding time was produced.

The normal platelet count, as given by different observers, ranges between 200,000 and 400,000. Hayem in his cases of purpura hæmorrhagica made counts of 89,000, 62,000 and 41,000. Bensaude and Rivet studied fresh blood films in 5 cases of purpura hæmorrhagica and noted that the platelets were greatly reduced. In studying purpura hæmorrhagica complicating nephritis, Pratt noted a count of 9,000. Selling, in a case of benzol poisoning with purpura hæmorrhagica, noted a platelet of 3,000.

Hayem, Denys, Bensaude and Rivet, Duke, Minot, and others, all agree in their observation of a striking tendency to bleed in patients with very low platelet counts, and in several instances note an amelioration of symptoms with a rise in the count. Duke, with his patients and animals, noted hæmorrhagic diathesis in mild form whenever the count was below 60,000, and in severe grade when the count was below 10,000.

It is interesting to mention in this connection the origin of blood platelets, since it seems likely that a certain type of purpura hæmorrhagica is due either to a reduced formation, or to an increased rate of destruction of platelets. The most interesting work in this relationship is that of J. H. Wright, who states, on the basis of microscopic examination of the bone marrow, that the source of the blood platelet is the megacariocyte of the marrow, and that platelets are formed by the budding off of pseudopods which are projected into the capillaries from the megacariocytes. His observations have been corroborated by other observers.

The characteristic symptoms of purpura of the platelet-free type are:

1. Petechia and ecchymosis. The rash may be modified by any co-existing skin lesions, or by mechanical agents, such as that produced by a bruise or by rubbing.

2. Bleeding from mucous membranes. This accompanies the petechia almost always, and ecchymosis usually.

3. Prolonged bleeding time. This was observed in all cases where there was a tendency to bleed with a return to normal immediately if the platelet count rises. This feature is found constant and distinctive, and it is the most reliable guide we have in showing the severity of hæmorrhagic diathesis in this type of trouble.

4. A reduced platelet count. This ranges from 60,000 to nearly nil. Usually the count is so reduced that the platelets can hardly be found in either counting chambers or blood smear. A rise above 10,000 is almost invariably associated with a reduction in the bleeding time, and an improvement in the patient.

5. Normal coagulation time.

6. Non-retractile clot. Retractility of the clot seems to depend on the presence of blood platelets, and returns when the counts rise to a certain limit (40,000).

The fundamental cause of many types of purpura is still unknown. Some evidently occur in connection with infections and with intoxications, and this would seem to point to a relationship of cause and effect. While it is not capable of demonstrable proof this suggestion must be given consideration.

It has been argued that purpura in pregnancy is no different from that in the non-gravid woman. A few observations of Henri Vignes on the changes in the blood of the normal pregnant woman are pertinent and interesting. In normal gestation he finds,

1. The blood mass is augmented by 8 per cent, through superabundance of serum.

2. The number of red blood cells is clearly diminished, as is also the hæmoglobin ratio.

3. The cells have the property of sedimenting with greater rapidity in pregnancy. Following the technique of Lingemeier, it takes 5 to 6 hours to precipitate *in vitro*, completely, the blood cells of a woman not pregnant nor in her menstruation. It requires less than 2 hours to produce the same phenomenon in a woman 7 or 8 months pregnant.

4. There exists as light leucocytosis, more marked in primiparæ. Baer gives the figures as 11,000 for primiparæ, and 6,000 for multiparæ. These figures are increased by 50 per cent during labor, and especially if there be an early rupture of the membranes. The increase is more particularly in the polymorphonuclears.

Consequently, when we consider that the barriers protecting the woman non-pregnant are broken down by the blood change occurring in the sixth or seventh months of pregnancy, there should be reason for her greater danger from purpura.

Ferroni believes in the classic theory which attributes the hæmorrhagic troubles of purpura to a lesion either of the kidney or the liver, under the influence of the nervous system, this applying more distinctly to purpura gravidarum.

The new ideas of E. Frank and Kaznelson, who speculate on the preponderant rôle played by the spleen in the pathology of purpura, are interesting, but they are not as yet confirmed by a long experience.

John Phillips, in an elaborate discussion of purpura in menstruation and pregnancy, says that women with amenorrhœa or irregular menstruation have a disposition to erysipelas of the face, erythema nodosum, purpura simplex, and purpura hæmorrhagica, which he thinks are only degrees of the same hæmorrhagic disorder. He reports 3 cases of purpura in non-pregnant females occurring at the menstrual time, one of whom died of hæmorrhage.

Peusch reports a woman of 21, who, a year after the birth of a child, had a severe headache and petechiæ. In 10 days a normal menstruation of 3 days' duration occurred. Her next period was at the proper time, but excessive. On the fourth day she fainted. Hæmorrhage from the bowel was profuse and a uterine hæmorrhage followed, which continued for 10 days. After several weeks the rash disappeared and she made a slow recovery.

From the foregoing description two facts are apparent:

1. Purpura may be related to a known disease of which it is a symptom, or it may be a complication showing the violence of the pathogenic germ.

2. It may be only the expression of a state of which the cause is unknown, residing probably in the functional modification brought by the pregnancy into the maternal organism. This last series of cases is denominated idiopathic purpura.

Among the affections which determine purpura in pregnancy is scurvy, which Zangemeister remarked in his case. He argued that the scurvy shows symptoms so slightly at variance with the gastro-intestinal conditions, progressive anæmia, muscular and articular pains, and cutaneous hæmorrhages, which one meets in gestation, that differentiation is difficult and the same form of disturbance is likely responsible.

The evolution of symptoms is similar to those in the cases reported by Bregier and Ferroni, where the general picture resembled scorbutic purpura, but the affection taking a serious turn may go on in one instance to a fatal termination, while in another the patient recovers her equilibrium with no untoward result.

Well-defined hæmophilia is always easily recognized, but there are in addition instances like that which Grazzani reports of women not hæmophiles who, nevertheless, bleed excessively when they are pregnant and in labor and also postpartum. This circumstance is also noted by Phillips and Rowe, as if pregnancy had reinforced the tendency of the scorbutic cachexia responsible for much disorder in the maternal organism, interfering with its repair, even after the expulsion of the products of conception.

Diehl, in a classification of purpura, includes scorbutic purpura and maintains that the petechiæ are in this case secondary to the scorbutic cachexia. Purpura due to tuberculosis, malaria, and cardiopathies are analogous. He says to differentiate scurvy in pregnancy is

difficult, as the gestation itself is often accompanied by alimentary disturbances reflex in origin.

From a clinical point of view the facts present themselves in the great majority of cases as follows:

The victim is usually a multipara. Her age is from 22 to 35 years. The patient shows at first the appearance of good health, and the family history may be negative. Her former pregnancies have been normal and each one terminated with the birth of a full term, living infant. Her present pregnancy may have been normal or there may have been a complication of metrorrhagia of sufficient importance to attract attention, when the woman finds herself again enciente. The beginning of the pregnancy is not marked by any serious accident. At this time she may have noted a peculiar odor which seems to come from a fermentation of gastro-intestinal origin. To all appearances, however, she is in good health and her gestation shows no untoward symptoms until sometime in the sixth or seventh month she experiences a vague discomfort, loses appetite, and complains of headache; she has palpitation and a gastro-intestinal trouble which becomes more marked. Some time later there appear hæmorrhagic spots on the skin, then petechiæ, which are at first discrete, but later become confluent. These spots usually appear in successive crops. The woman finds that her gums are tumefied and painful and begin to bleed; epistaxis becomes troublesome; she usually has a persistent diarrhœa; she consults a doctor, who finds that the fetus is living, but that the mother has purpura with symptoms of grave character. The patient is usually pale and depressed, short of breath, although no abnormal symptoms can be found in the heart, lungs, or other organs. Blood pressure may be normal, the pulse is rapid, corresponding with that of a light fever. A trace of albumin is usually found. She may improve. The reverse is generally the case. Gastro-intestinal troubles increase. Mucous hæmorrhages are frequent. The patient bleeds from the mouth, the nose, the bladder, and the rectum. She becomes rapidly anæmic and exhausted, is confined to her bed. Hæmorrhages increase from all mucous surfaces, the temperature rises. She goes into rapid labor without great pain. She is delivered normally and may begin to improve. Generally, however, she dies after a few hours or a few days because, for some reason, the organism cannot re-establish itself after expulsion of the products of conception.

PROGNOSIS

The prognosis in cases where purpura hæmorrhagica complicates pregnancy becomes very grave. The outcome is generally less serious when an early abortion ensues. Only occasionally a patient goes to term and recovers. Involution is more or less prolonged.

In half of the cases the fetus perishes *in utero*, or dies within a few days following the birth. It presents, usually, however, a normal appearance. Very rarely there develop hæmorrhagic accidents to the fetus, analogous to those of the mother.

A brief list of case reports instructs one on the prognosis.

Phillips, two cases, British Lying-in, 1887. One, age 32, para-VII, recovered, the other died of hæmorrhage the second day following delivery.

Peuch, primipara, sixth month, epistaxis, petechiæ, no external hæmorrhage, died the fifth day.

Peuch, para-V, age 30, eighth month, petechiæ suddenly overspread the entire body, fetus expelled the same night, postpartum hæmorrhage, death.

Budd Van Sweringen, Ft. Wayne, 1905, primipara, sixth month, whose cervix had been thrice cauterized by preceding attendant for pernicious vomiting,—found nose bleeding and gums oozing, bloody urine, profuse vaginal discharge, profound dyspnœa, petechiæ general over body, slight temperature. Symptoms cleared up in a few days. Delivered 3 months later with no purpuric symptoms.

Robert Barnes, Brit. M. J., para-III, sixth month, rheumatic pains, fever, premature fetus lived 3 hours, purpuric spots appeared same day. Prostration, delirium and hæmorrhage were followed by death in a few hours.

Barnes and Byrnes, Brit. M. J., Nov., 1867, patient developed spots of purpura hæmorrhagica, subconjunctival ecchymoses, prostration and delirium, died day after delivery. Two days later her husband developed variola.

Wiener, Arch. Gynaek., 1887, xxi, 281, hæmorrhagic purpura in two sisters: the first dies suddenly after rash appears, the second is taken 14 days later in seventh month with identical symptoms, is delivered next day. During delivery a scarlatiform rash appears on head, neck, and trunk, hæmorrhages of skin present themselves, bloody expectoration, hæm-

aturia, sanguinolent stools. Woman dies third day with no elevation of temperature. At the time an epidemic of small pox prevailed in Breslau.

Ferroni, Rome, 1903, para-IV, age 31, sixth month, discrete petechial rash localized on thorax and lower limbs. After 12 days bloody stools, albuminuria, profound anæmia. Suddenly delivered voluntarily of living baby showing no traces of purpura. Two hours later after declaring she felt better, she suffered profound dyspnœa which was followed by loss of consciousness and death.

Diehl, Ztschr. f. Geburtsh., 1899, p. 218, reports a para-VII, age 36, no history of bleeders, six confinements normal. Patient expelled dead fetus at eighth month, no notable bleeding. Later she developed general purpuric hæmorrhages, uterus at umbilicus became gangrenous and there was a vaginal discharge. Blood examination was negative. Six days later patient suffered violent pain, and petechiæ and ecchymoses succeed in crops; she had no fever, but died on eighth day.

Hanot and Luzet, Arch. Exp. Med. & Path. Anat., 1891, xv, 772. Primipara, age 22, at term suddenly suffered occular disturbance and coma; petechiæ and ecchymoses appeared, a macerated fetus was expelled. The next day patient went into deep coma, albumin was notable, and woman died. Autopsy showed cerebric spinal meningitis.

Le Clerc, Lyon médical, 1908, reports a hæmophilic, age 32, para-V, with three living children, one a hæmophilic. Purpura at third month with epistaxis, bleeding of gums, and conjunctival effusions. Fourteen days later she was delivered with slight loss of blood of a dead child. Blood examination showed polymorphonuclears 86 per cent, mononuclears 13 per cent, non-retractile clot, normal coagulation time. Patient died next day.

TREATMENT

As to the treatment of purpura hæmorrhagica little is to be said. The use of drugs, either styptics, general remedies, or serums, has been found futile. Complete rest should be advised, and patient should eat nourishing food, and perhaps be given a tonic.

Transfusion is the only effective means of controlling the hæmorrhage, and may have a prolonged or even permanent effect. The theory suggested by Duke that the increased blood platelet count—above 10,000—results in control of the hæmorrhage, seems a plausible one to account for the favorable result.

Repeated transfusion may be required to tide over a temporary process which caused a platelet deficiency, and this may lead to a cure. At present no other method of treatment has been found worthy of trial.

AUTHOR'S CASE

The especial reason for the presentation of this subject at this time is that, during the summer of 1922, the author saw in consultation with a very careful diagnostician and able practitioner, his friend, Dr. John I. Byrne, of St. Joseph, Missouri, a case of purpura hæmorrhagica complicating pregnancy, in a patient whose history is appended.

Mrs. A. F. S., age 36, para-VI. She has always been under the care of Dr. Byrne in each of her labors. Her first confinement was perfectly normal. The second child was born without untoward symptoms, but in the third month following the birth the mother developed an acute appendicitis. The appendix was perforated within 12 hours after the onset of pain. Operation was followed by a somewhat stormy convalescence and complete recovery.

The third pregnancy began soon after the recovery from the appendicitis. She became toxic and several convulsions were suffered, but the child was delivered near term and lived. Her fourth and fifth pregnancies were normal in every respect.

The present trouble developed in the sixth month of the last pregnancy with painful purpuric spots on the legs and abdomen, and these gradually affected the whole body. At the end of 3 weeks, hæmorrhage from the gums and nose began. At that time 10 cubic centimeters of normal horse serum was given and this completely controlled the symptoms for 3 weeks. Then followed repeated hæmorrhages from the bowels, nose, and gums. She was desensitized and the horse serum was repeated, but it failed to stop the bleeding. A transfusion of 350 cubic centimeters of citrated blood was given. This partially controlled the hæmorrhage but oozing was still observed. Various styptics, such as calcium lactate and stypticin, were given, but without effect.

Because of fear of more extensive bleeding consultation was called and it was decided, as the patient was becoming more anæmic and consequently weaker, that an induction of labor should be done before the control of the transfusion was exhausted.

Accordingly, in anticipation, another transfusion was done and the Voorhees bag was used to inaugurate labor pains. After 6 hours, a baby girl, weighing 6½ pounds, was delivered and lived 10 hours. The child seemed strong and well developed, but it was noticed in a short time that wherever it had been touched by the hands large ecchymotic spots appeared. The ecchymoses gradually increased although there was no hæmorrhage from mucous membranes. This feature is of especial interest from the viewpoint of heredity, since, in nearly all of the other cases found where purpura developed, there was no evidence of the condition being transmitted to the offspring. The authors quoted, where mention is made of the subject, usually observe that the purpura was not transmitted. This child was

evidently a bleeder, and the source of its disturbance was like that of the mother, probably a toxæmia. In this particular, the case is, so far as we have been able to determine, unique in that both mother and child suffered from an identical condition.

There was no time during this last pregnancy any sign of kidney disturbance, and while the bleeding from other mucous membranes was quite free, no blood was found in the urine. There was no excessive bleeding following the birth, and all other hæmorrhages promptly ceased as soon as the patient was delivered. She was discharged from the hospital at the end of 2 weeks after the birth and is now, apparently, in better health than usual.

CONCLUSIONS

1. Purpura is a very rare complication of pregnancy. The literature includes 39 cases previous to this report.

2. Purpura in gestation is most often of the hæmorrhagic form, characterized by these symptoms: hæmorrhages from mucous surfaces; petechiæ and ecchymoses; a remarkably reduced platelet count; prolonged bleeding time; normal coagulation time and non-retractile clot as in the non-gravid woman similarly affected. With the gravid woman, however, there is greater frequency of metrorrhagia.

3. Beside the purpura hæmorrhagica associated with a definite pathological state complicating gestation, there are others more rare, which may be denominated idiopathic purpura of gestation.

4. Idiopathic purpura always manifests a harmful influence in gestation, usually resulting in premature delivery.

5. Multipara between the ages of 22 and 35 are most often affected. Usually the patient is in the sixth or seventh month of her pregnancy.

6. Purpura is frequently complicated by infection, but some cases occur without any real evidence of infection. Toxæmias appear responsible for a number of cases.

7. The offspring of purpuric mothers are not usually affected by the eruption, although in the present case, the child developed ecchymoses.

8. The fetal mortality is 50 per cent.

9. Nearly all cases of purpura hæmorrhagica which go to term end fatally at the delivery, or soon after the labor, from hæmorrhage.

10. No drug therapy is of the slightest avail. Direct transfusion of blood, keeping the platelet count over 10,000, is the only remedy. Repeated transfusion may be necessary to tide the patient over the period in which her platelet count is reduced.

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A FURTHER DISCUSSION OF GERMICIDES AND PRESENTATION OF A NEW GERMICIDE—MEROXYL

By HUGH H. YOUNG, M.D., F.A.C.S., EDWIN C. WHITE, Ph.D., JUSTINA H. HILL, M.S.,
AND
DAVID M. DAVIS, M.D., Baltimore

From the Brady Urological Institute, Johns Hopkins Hospital, Baltimore. Researches aided by funds from the Interdepartmental Social Hygiene Board

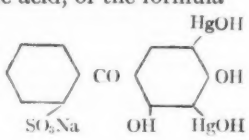
TWO of the present writers in conjunction with Dr. E. O. Swartz, presented in 1919[1] and again in 1921,[2] papers on a new mercurial germicide, mercurochrome. In these papers we set forth the reasons for an attempt to make improvements in the antiseptic treatment of wounds and mucous surfaces, and gave in considerable detail the bacteriological, animal, and other laboratory experiments, and the clinical results which we had obtained with the powerful mercurial germicide to which we gave the name of mercurochrome. Since these papers were written a considerable number of clinical papers has appeared, and the position of mercurochrome as a valuable germicide has been established.

Work on the drug which is the subject of this paper had its inception in an attempt to produce a substitute for mercurochrome which would retain the therapeutic properties of that drug but be without the stain. In other words, search was made for a mercurial which should at once have high germicidal value, sufficiently low toxicity to permit its use in body cavities, as little irritation as possible for delicate tissues and *penetrating power without staining*, or what might be called "invisible staining." The properties possessed by the drug which we have called "meroxyl"[3] do not correspond exactly with the desiderata just mentioned as an ideal, in that some of the desirable features have been intensified at the expense of others. The new drug was found to be far more powerful as a germicide, *in vitro*, than mercurochrome and to be entirely free of staining quality. On the other hand the toxicity was found to be higher than that of mercurochrome, the precipitating action on protein more noticeable (with consequently greater irritation to tissues) and *no evidence was found of the power of the drug to penetrate tissues*. From a laboratory standpoint, therefore, it appeared probable that the usefulness of the drug would lie particularly in those fields in which the more superficial, easily reached infections were to be dealt with.

Experience in various branches of medicine and surgery has shown that the new drug is to be regarded as a complement of mercurochrome but by no means a substitute for it. Where deep penetration and extreme blandness are of prime importance or where it is desired to secure a permanent deposit of a disinfective agent which will not be rapidly washed away by body fluids, the new drug, meroxyl, has certainly not been found superior to mercurochrome and is probably not as effective. On the other hand, for purposes such as surgical irrigation and dressing of wounds meroxyl seems to have a wide field of usefulness not possessed by mercurochrome. This general suggestion is made as to the indications for the use of meroxyl because our experience with mercurochrome, which was originally intended only as a urinary antiseptic, shows that when a new drug is made generally available experiments will be made with it in practically all therapeutic directions.

DESCRIPTION OF MEROXYL

Meroxyl is the sodium salt of 2-4-dihydroxymercuri-3, 5-dihydroxybenzo phenone-2′-sulphonic acid, of the formula



[1] Young, H. H., White, E. C., and Swartz, E. O. A new germicide for use in the genito-urinary tract: "mercurochrome-220." J. Am. M. Ass., 1919, lxxiii, 1483–1491.

[2] Young, H. H., White, E. C., and Swartz, E. O. Further clinical studies on the use of mercurochrome as a general germicide. J. Urol., 1921, v, 353–388.

[3] As will be apparent from the structural formula, the hydroxyl groups are important factors in determining the properties of the parent organic substance as regards mercuration. The derivation of the name "meroxyl" is then obvious. During nearly 2 years of clinical experimentation the drug has been known by the laboratory number "253."

The product is formed by the mercuration of the parent organic substance, but the impossibility of complete mercuration, on mechanical grounds, and the difficulty of isolating the pure substance in any considerable quantity have led us to use a mixture which contains about 50 per cent of the pure compound, the remainder being made up of unmercurated parent substance, moisture, and inert inorganic salts. This mixture has served well clinically, so it does not seem necessary to work with the pure material. *In stating the strengths of solutions hereafter we give figures referring to the content of pure compound.*[1]

The mixture is a flesh colored to pink powder, stable indefinitely, easily soluble in distilled water. Solutions as strong as 5 to 10 per cent can be prepared with hot water but tend to gel or deposit the material on cooling and standing. Weaker solutions up to 2.5 per cent are permanent as far as fluidity is concerned but deteriorate in germicidal value. We have made it a practice never to use solutions older than a week.

The color of the solutions varies with concentration. A 0.5 per cent solution shows a peculiar pale, brownish-pink color with slight green fluorescence. This color tends toward brown in stronger solutions or thicker layers, and toward pink in more dilute solutions or thinner layers. In spite of the rather marked depth of color in solution, the drug produces no stain whatever on the skin or on fabrics.

The powder contains about 25 per cent of mercury, whereas the formula for the true substance given above requires a content of 53.5 per cent of the metal. The low mercury content of the powder is not due to the presence of any *mono*-mercury derivative, for the isolation of pure substance shows the formation of the dimercury derivative even when the ratio of mercurating agent to parent substance is 1:1 or less.

Solutions of meroxyl give no precipitate with sodium hydroxide or potassium iodide, showing that the mercury is in non-ionic form. The behavior with ammonium sulphide depends on the strength of the solution. A 2.5 per cent solution blackens almost instantaneously, a 1 per cent solution after a few seconds, and a 0.5 per cent solution remains clear for a time, but usually blackens within a minute, a cloud spreading through the solution suddenly, like a blush. This reaction was taken advantage of in attempts to demonstrate penetrative power of the drug in tissues. Solutions of meroxyl as strong as 0.5 per cent form a slight cloud with serum, but weaker solutions (1:1000 or less) do not show precipitating action on protein.

A characteristic reaction of this drug is that it behaves like a phenol and couples with diazo solutions to form dyes. The compound formed with diazotized p-nitraniline has a deep bordeaux-red color.

Attempts to demonstrate penetrating power of meroxyl. Since meroxyl does not stain tissues, experiments bearing on the question of its penetration require that the drug be "developed" into a precipitate or a brightly colored substance. For this purpose the reactions with ammonium sulphide, whereby a black insoluble precipitate of mercuric sulphide is formed, and with diazotized p-nitraniline, whereby a dye is formed, were utilized.

A solution of meroxyl was injected into the excised bladder and kidney of a rabbit, washed out after three minutes, frozen sections were cut in a direction perpendicular to the surface of application, the "developers" were applied and the sections were examined microscopically. The method of development of a dye was found unsuitable. Some of the meroxyl adhering to the mucosa, of course, developed into dye, but this was water-soluble and the dye solution distributed itself over the whole section, masking any penetration that might have taken place. The method of precipitation of mercuric sulphide proved feasible, as the substance developed consisted of dark, insoluble particles which did not run. Unfortunately, their presence was found to be confined to the surface of the mucosa, indicating that the meroxyl solution had not penetrated to any depth.

Toxicity. Toxicity was determined on dogs, by intravenous injections and by feeding through a stomach tube. The first method showed rather high toxicity. The tolerated

[1] In preparing solutions from the powder we have used twice as much powder as the true strength indicates. Thus, two grams of powder in 100 cubic centimeters of water makes a 1 per cent solution. It is, of course, possible to prepare tablets such that one tablet in a suitable volume will make a solution of a desired strength based on content of pure drug.

dose was 1 cubic centimeter of a 0.25 per cent solution per kilogram of body weight, or 2.5 milligrams of the pure substance per kilogram. This dose produced albumin and casts in the urine, but no decrease in phthalein output. After one month albumin was still present, there were no casts, and the phthalein output was normal. Two cubic centimeters of a 0.25 per cent solution per kilogram was fatal, a heavy albuminuria being produced within a day, with suppression of phthalein output to a trace, and death 2 days later. A dose of one-half the tolerated dose — 0.5 cubic centimeter of 0.25 per cent solution, or 1.25 milligram of pure substance per kilogram apparently had no effect whatever on the animal, urine findings being entirely negative 1 week after the injection, with normal phthalein output.

The toxicity after oral administration is low. The maximum amount of a 0.5 per cent solution of the powder that a dog will retain is 10 cubic centimeters per kilogram; larger amounts are lost by vomiting. Retention of the amount indicated led to a diarrhœa lasting 1 day and a very slight decrease in phthalein output, which, however, returned to normal within a week. As this dose is equivalent to a total of about 600 cubic centimeters in a man, it seemed quite safe to use small amounts of dilute solutions of the drug in body cavities, where it was unlikely that there would be even as high a degree of absorption as from the stomach and intestines. Early clinical experiments on the use of the drug in the genito-urinary tract were therefore made cautiously and with dilute solutions. We have used this drug extensively for about a year and a half, in which period we have observed only two cases in which there was any evidence at all of toxic absorption and in these cases it was slight and transient. These two cases will be referred to in the clinical part of the paper.

Bacteriological tests with meroxyl. The action of meroxyl *in vitro* has been studied in three media of exposure, 0.875 per cent sodium chloride solution, normal urine of PH 6.4, and 50 per cent dog serum. In this way, close approximation of the action of the drug under widely varying conditions has been obtained. The tests in 0.875 per cent sodium chloride solution furnish an estimate of the action of the drug in the absence of organic matter and are the most favorable, while the tests in 50 per cent serum are more rigid than in the average medium of action of the drug *in vivo*, and are the most unfavorable experimentally. The unavoidable variations in the chemical composition of different urines, used for tests, are paralleled by similar variations clinically.

The action of the drug was studied chiefly against bacillus coli, staphylococcus pyogenes-aureus and the gonococcus, with some tests against pseudomonas pyocyanea and bacillus pneumoniæ. Parallel tests were made with three strains of each organism, in order to lessen the source of error of possible variation of any one strain.

All organisms except the gonococcus were tested by the following method: 5 cubic centimeters of the sterile medium of exposure was inoculated with 1 loopful of a 24-hour broth culture of the test organism, the culture having been filtered through glass-wool to remove clumps of organisms. The number of organisms added was estimated by dilution and plating. To this organism-medium of exposure mixture was added 0.5 cubic centimeter of the drug, eleven times the strength of the final dilution desired $\left(\frac{5.0+0.5}{0.5}=11\right)$. The drug was always added after the organisms, to eliminate the possibility of any drug-medium combination without organisms. At

TABLE I.—BACTERICIDAL VALUES OF MEROXYL AGAINST BACILLUS COLI AND STAPHYLOCOCCUS PYOGENES-AUREUS IN 50 PER CENT DOG SERUM, PH 6.4 URINE AND 0.875 PER CENT SALT SOLUTION

Exposure Time	B. coli, strain 1 (average number of organisms per c. cm. before addition of drug, 1,075,000)			Staphylococcus pyogenes-aureus, strain 1 (average number of organisms per c.cm. before addition of drug, 2,364,000)		
	0.875 per cent NaCl.	P.H. 6.4 urine	50 per cent dog serum	0.875 per cent NaCl. serum	P.H. 6.4 urine	50 per cent dog serum
1 minute	1:10,000	1:10,000	1:10,000	1:600	1:600	1:600
5 minutes	1:20,000	1:20,000	1:10,000	1:2,000	1:700	1:700
60 minutes	1:200,000	1:70,000	1:20,000	1:4c0,000	1:10,000	1:2,000

TABLE II.—TABLE OF COMPARATIVE BACTERICIDAL VALUES OF MERCUROCHROME AND MEROXYL

	MERCUROCHROME				MEROXYL			
Exposure time	1 minute		1 hour		1 minute		1 hour	
Medium	50% serum	Norma NaCl.	50% serum	Normal NaCl.	50% serum	Normal NaCl.	50% serum	Normal NaCl.
B. coli 1	1:200	1:200	1:600	1:200,000	1:10,000	1:10,000	1:20,000	1:200,000
B. coli 117	1:100	1:100	1:500	1:100,000	1:6,000	1:8,000	1:20,000	1:600,000
B. coli 118	1:100	1:200	1:500	1:100,000	1:6,000	1:12,000	1:20,000	1:400,000
3-strain average	1:100	1:150	1:500	1:100,000	1:7,000	1:10,000	1:20,000	1:400,000
Staph. pyogenes-aureus 1	1:90	1:100	1:200	1:70,000	1:600	1:600	1:2,000	1:400,000
Staph. pyogenes-aureus 2	1:90	1:90	1:200	1:200,000	1:400	1:400	1:4,000	1:400,000
Staph. pyogenes-aureus 3	1:90	1:100	1:200	1:100,000	1:400	1:600	1:6,000	1:800,000
3-strain average	1:90	1:90	1:200	1:100,000	1:400	1:500	1:4,000	1:500,000
Ps. pyocyanea 279	1:100	1:100	1:300	1:100,000	1:600	1:1,000	1:10,000	1:1,000,000
Ps. pyocyanea 280	1:100	1:100	1:300	1:200,000	1:200	1:1,000	1:10,000	1:400,000
Ps. pyocyanea 282	fails 1:50	1:90	1:200	1:100,000	1:200	1:1,000	1:8,000	1:800,000
3-strain average	1:60	1:90	1:200	1:100,000	1:300	1:1,000	1:9,000	1:700,000
B. pneumoniæ 1	fails 1:50	1:90	1:400	1:70,000	1:4,000	1:4,000	1:10,000	1:2,000,000
B. pneumoniæ 98	fails 1:50	1:90	1:500	1:60,000	1:6,000	1:10,000	1:10,000	1:1,000,000
B. pneumoniæ 99	1:50	1:100	1:700	1:80,000	1:3,000	1:10,000	1:8,000	1:1,000,000
3-strain average	1:10	1:90	1:500	1:70,000	1:4,000	1:8,000	1:9,000	1:1,000,000

3-strain averages are put as the nearest round number below the arithmetical mean.
Strains failing to kill 1:50 are counted as 0 in estimating 3-strain averages.
B. coli 117, 118; Ps. pyocyanea 279, 280, 282; B. pneumoniæ 98 and 99 were obtained from the Hygienic Laboratory; B. pneumoniæ 1, from the Johns Hopkins Medical School; other organisms from the Brady Urological Institute.
Killing dilution given indicates failure to kill at next dilution.

the end of the desired exposure time, 0.1 cubic centimeter of the final mixture was removed and planted in beef-infusion broth, PH 7.6, proper dilution being made through test dilutions of 1:5000 to check possible inhibition in the broth, due to carrying over the drug, as determined by control tests. Tubes were then incubated for 48 hours at 37.5° C., the exposure having been made at room temperature. Drug dilutions were used as follows: to 1:100 by tens; from 1:100 to 1:1000 by hundreds; from 1:1000 to 1:10,000 by thousands; from 1:10,000 to 1:100,000 by ten thousands; from 1:100,000 to 1:1,000,000 by hundred thousands; 1,000,000 and more by millions. Three tests were made each time on each dilution, and the final reading which showed three sterile tubes after 48 hours' incubation, with growth in one or more of the tubes of the next weaker dilution, was taken as the killing dilution. Tests were repeated on different days, and were carefully controlled for sterility of the media of exposure and of glassware, for the purity of the cultures used and for positive untreated organism transfers. The results of these tests for meroxyl are expressed in Table I. Turning to this table, one is struck at once with the fact that at the end of exposures lasting 1 to 5 minutes, the germicidal power of the drug for bacillus coli is very high, not only in salt solution, but equally so in urine and 50 per cent dog serum. It is, therefore, demonstrated that for these periods the germicidal power of the drug is not diminished in the presence of albumin or urine, a most important factor in the clinical use of antiseptics. This is not true of many other germicides. At the end of an hour the inhibiting effects of serum and urinary constituents become apparent, although this is more evident in the case of staphylococcus than of bacillus coli. Table I alone is sufficient to point out the probability of great clinical value for meroxyl.

Table II shows the comparative bactericidal values of mercurochrome and meroxyl.

We have chosen mercurochrome to be compared with meroxyl because mercurochrome is a related mercurial of established value, which has been studied in the same general way. An analysis of Table II shows the high germicidal strength of meroxyl for pyocyaneus and bacillus pneumoniæ. The table is also instructive as demonstrating the marked inhibition produced by the serum upon antiseptics in one hour tests.

Table III gives the bactericidal value of various drugs against the colon bacillus in 50

TABLE III—BACTERICIDAL VALUE OF DRUGS AGAINST BACILLUS COLI IN SERUM AND SALT SOLUTION

Drug	Strength injectable in urethra	Serum 50 per cent				Sodium chloride solution			
		Killing strength 1 minute	Therapeutic factor—1 minute	Killing strength 1 hour	Therapeutic factor—1 hour	Killing strength 1 minute	Therapeutic factor—1 minute	Killing strength 1 hour	Therapeutic factor—1 hour
Phenol	1:50	1:100	2	1:200	4	1:100	2	1:500	10
Potassium permanganate	1:2,000	1:200	0.1	1:200	0.1	1:10,000	5	1:20,000	100
Mercuric chloride	1:20,000	1:10,000	0.5	1:30,000	1.5	1:80,000	4	1:1,000,000	50
Argyrol	1:10	1:100 fails		1:200	20	1:100 fails		?	
Protargol	1:50	1:200 fails		1:1,000	20	1:200 fails		1:8,000	160
Silver nitrate	1:5,000	1:10,000	2	1:10,000	2	1:10,000	2	1:10,000	2
Acriflavine	1:1,000	1:200 fails		1:200 fails		1:200 fails		1:4,000	4
Flumerin	1:100	1:100 fails		1:100 fails		1:100 fails		1:8,000	80
Mercurophen	1:4,000	1:1,000	25	1:10,000	25	?		?	
Mercurochrome	1:100	1:200	2	1:600	6	1:200	2	1:200,000	2,000
Meroxyl	1:200	1:10,000	50	1:20,000	100	1:10,000	50	1:200,000	1,000

per cent serum and in salt solution. In this table we have included columns which show as follows: Column 1 gives the strength of the drug which can ordinarily be injected into the urethra with impunity. This may be taken as a fair index of what strength may be employed upon other mucous surfaces, but it is well known that the nose and throat will tolerate far greater strengths than the urethra, and we may add that it is possible to use some of these drugs for one or two applications in much stronger solutions than are here given.

Column 2 shows the germicidal value of the drug, the strength at which the organism kills or fails to kill in one minute. From these two columns a therapeutic factor is derived which indicates the presumptive curative value of the drug when used in dilutions which are commonly employed or may be used for limited periods without injury or pain. This therapeutic factor gives an interesting forecast of the practical value of the drug in treatment, so far as can be deduced from laboratory experiments. It will be noticed that while bichloride of mercury will kill the colon bacillus at a strength of 1:10,000 in 1 minute, it cannot be used as an irrigation stronger than 1:20,000 in the urethra (and generally much weaker than this). Therefore, its therapeutic factor (which is derived by dividing the killing strength by the usable dilution), is less than one (0.5).

In the other columns the same factor is worked out in serum for the one hour tests, and in salt solution for one minute and one hour tests. Four columns of therapeutic factors are therefore presented which show graphically the value of eleven different antiseptics for different lengths of time, in salt solution or serum. It is thus possible to get an idea of the value of the drug for the conditions met with clinically. A survey of the columns giving the therapeutic factor for one minute in serum shows that meroxyl is twenty-five times as effective as any other drug. In fact nitrate of silver, mercurochrome and carbolic acid are the only three which approach within one-twenty-fifth of the value of meroxyl according to this factor in the short exposure of one minute in serum. At the end of an hour the difference is not so great and argyrol, protargol, and mercurophen approach to within one-fifth or one-tenth of the value of meroxyl. In the case of permanganate of potash and nitrate of silver in the presence of serum the effect of the drug is no greater in one hour than at the end of a minute. In other words the chemical reaction between the serum and drug neutralizes the action of the antiseptic almost at once.

The next two columns of factors which give the therapeutic value of the drug in salt solution are not nearly so valuable as the conditions present do not approximate those found in the body. In salt solution all antiseptics are more active, as a result of being freed from the inhibiting action of serum. For example, the albumin in serum reduces potassium permanganate to manganese oxide which is inert. In the case of silver nitrate the chlorides in the serum precipitate the silver at once as

TABLE IV.—BACTERICIDAL VALUE OF DRUGS AGAINST STAPHYLOCOCCUS AUREUS IN SERUM AND SALT SOLUTION

Drug	Strength injectable in urethra	Serum 50 per cent				Sodium chloride solution			
		Killing strength 1 minute	Therapeutic factor—1 minute	Killing strength 1 hour	Therapeutic factor—1 hour	Killing strength 1 minute	Therapeutic factor—1 minute	Killing strength 1 hour	Therapeutic factor—1 hour
Phenol	1:50	1:100 fails		1:100	2	1:100 fails		1:400	8
Potassium permanganate	1:2,000	1:100	0.05	1:100	0.05	1:1,000	0.5	1:100,000	50
Mercuric chloride	1:20,000	1:3,000	0.15	1:9,000	0.45	1:40,000	2	1:1,000,000	50
Argyrol	10%	1:100 fails		1:100	10	1:100 fails		1:10,000	1,000
Protargol	2%	1:200 fails		1:900	18	1:200 fails		1:1,000	200
Silver nitrate	1:5,000	1:3,000	0.6	1:3,000	0.6	1:4,000	0.8	1:4,000	0.8
Acriflavine	1:1,000	1:200 fails		1:200 fails		1:200 fails		1:3,000	0.75
Flumerin	1:100	1:100 fails		1:100 fails		1:100 fails		1:5,000	50
Mercurophen	1:4,000	1:10,000	2.5	1:30,000	7.5	?		?	
Mercurochrome	1:100	1:90	0.9	1:200	2	1:100	1	1:70,000	700
Meroxyl	1:200	1:600	3	1:2,000	10	1:600	3	1:400,000	2,000

insoluble silver chloride, but this is true also in salt solution, so that the results with nitrate of silver are the same in serum and in salt solution, with a very low therapeutic factor, viz., 2, in each.

In salt solution meroxyl again shows its superiority both for 1 and 60 minute tests over all drugs except mercurochrome, which equals it in 60 minute tests. Owing to the great penetration of the stain and its lasting effect, after several days, mercurochrome is probably more valuable as an antiseptic than meroxyl in certain cases, especially in those cases such as external wounds, skin surfaces and glandular organs where penetration and prolonged action are desirable.

Table IV is similar in every respect for the same drugs tested against staphylococcus pyogenes-aureus, and the results obtained are very similar to those mentioned above for the colon bacillus. It is evident, however, that meroxyl is proportionately more powerful against the colon bacillus than against the staphylococcus. It is noteworthy here that next to meroxyl mercurophen is the most active antiseptic in serum for one minute exposures with the staphylococcus, and next in order is mercurochrome. But here again the question of permanent and lasting effect is not shown by the tables, and this, after all, is one of the most important questions in practical application of antiseptics to wound surfaces and deep mucous cavities and in the treatment of glandular organs where absorption and deep penetration is desirable.

The gonococcus tests were made by the Swartz and Davis[1] method of which they describe briefly as follows:

"One cubic centimeter of the emulsion is pipetted into a centrifuge tube of diluted drug. The tube is placed in the water bath at 37.5° C. for 18 minutes. At the end of this time, it is centrifuged at high speed for 2 minutes. The supernatant fluid is poured off, and a quantity of salt solution pipetted in. This makes the complete time of action of the drug 20 minutes. The tube is then spun a second time and the wash fluid poured off. The gonococci settle readily in the centrifuge tube and form a compact mass at the tip of the tube, which can be transferred almost *en masse* to a tube of fresh media. This is corked and incubated, as described by Swartz. It is our custom to inoculate after 7 days all tubes upon which no growth has occurred with fresh cultures of gonococci. If they develop, we assume that enough of the drug has not been carried over to the test medium to prevent growth. All final growths are examined microscopically with the Gram stain."

The 5 minute gonococcus tests were made by the same method. The results of the meroxyl gonococcus tests are expressed in Table V where, with the exception of the acriflavine, mercurophen and meroxyl tests, the figures of Davis and Swartz are quoted.[2]

On analyzing Table V, it is proper to state that the technique of carrying out bacteriological and germicidal tests upon the gonococcus is far more difficult than with the organisms previously mentioned. The gonococcus being a much more delicate organism, the conditions of the experiment have to be made somewhat

[1] Swartz, E. O., and Davis, D. M. The action on the gonococcus of various drugs commonly used in the prophylaxis and treatment of gonorrhea. J. Urol., 1921, v, 235–247.
Swartz, E. O., and Davis, D. M. Action of mercurochrome 220 on the gonococcus. J. Am. M. Ass., 1921, lxxvi, 844–846.

[2] *Loc. cit.*

TABLE V.—BACTERICIDAL VALUE OF DRUGS AGAINST THE GONOCOCCUS IN WEAK SERUM

Drug	Strength injectable in urethra	Killing strength 20 minutes	Therapeutic factor 20 minutes	Killing strength 5 minutes	Therapeutic factor 5 minutes
Meroxyl	1:200	1:80,000	400	1:40,000	200
Pot. Merc. Iodide	1:1,000	1:40,000	40		
Mercurophen	1:4,000	1:40,000	10		
Mercurochrome	1:100	1:16,000	160	1:4,000	40
Acriflavine	1:1,000	1:5,000	5		
Chlorazene	1:400	1:3,200	8		
Potassium permanganate	1:2,000	1:2,000	1		
Argyrol	10%	1:800	80		
Cargentos	10%	1:800	80		
Silvol	10%	1:400	40		
Protargol	2%	1:400	8		
Phenol	2%	1:200	4		
Boric Acid		2% fails			
Zinc Sulphate		1% fails			

TABLE VI.—TREATMENT OF GONORRHŒA (ACUTE ANTERIOR) WITH MEROXYL; 0.5 PER CENT INJECTED FOUR OR FIVE TIMES PER DAY

Gonococcus free in	Cases	Per cent
1 to 5 days	2	6.9
6 to 10 days	1	3.45
11 to 15 days	4	13.8
16 to 20 days	3	10.3
21 to 30 days	1	3.45
26 to 30 days	0	
30 to 35 days	2	6.9
Total apparently cured	13	44.8
Did not return 2nd time	5	17.25 (some may have been aborted)
Discontinued treatment after 11, 17, 9, 49, 19, 11 days, G. C. still present.	6	20.7 (the failures)
Complications:		
Posterior urethritis	3	10.3
Epididymitis and prostatic abscess.	1	3.45
Peri-urethritis	1	3.45
Total complications	5	17.2
Total cases	29	

different and the antiseptics are subjected to contact with a greater number of organisms.[1] Owing to the necessity of separating the organisms in the centrifuge, it is impossible to obtain one minute tests and the five and twenty minute exposures are therefore adopted. Here again the therapeutic factor has been worked out and again meroxyl is shown to be far more germicidal than all the others; the next in order being mercurochrome. Argyrol shows a very high therapeutic factor owing to the fact that it can be used in high concentration, and the same is true of some of the other silver compounds, although their killing strength is low. The question arises, however, whether these colloidal drugs existing as suspensions of comparatively large particles have as great penetration as the other aqueous solutions, particularly those which have the character of stains, as acriflavine and mercurochrome. The high therapeutic value of potassium mercuric iodide is of interest, as has been shown by one of us in a previous paper. As regards gonococcal infections it seems evident that in several of these new antiseptics, and particularly in meroxyl, agents which may have great value are at hand. While most of these drugs produce little or no irritation at the strength mentioned, practical experience shows that all urethral injections and irrigations should be used fairly dilute; e.g., while acriflavine can be used at the strength of 1:1,000 without much irritation, E. G. Davis recommends that it be used in a strength of 1:8,000.

Meroxyl, as judged by laboratory tests, is a drug of particularly high germicidal value against the gonococcus and against bacillus coli. The high germicidal value of mercurochrome is well known; yet, compared with mercurochrome against the gonococcus, meroxyl is four times as effective in the 5 minute tests, and five times as effective in the 20 minute tests. Moreover, meroxyl is the strongest gonococcicide which has been tested to date by this method. Against bacillus coli, meroxyl is at least 150 times as germicidal as argyrol, and is equaled by mercurochrome only in the one hour tests in salt solution. In urine, meroxyl is twelve times stronger than mercurochrome in one minute exposure, twenty times as strong in five minutes, and fifteen times as strong in one hour. While of marked germicidal value against staphylococcus pyogenes aureus, meroxyl does not seem to exert as strong an action against these organisms as against the three genera of bacilli against which it has been tested. Compared with other drugs commonly used as germicides, meroxyl falls into the group of the most powerful, that is, it is comparable to bichloride of mercury, and to silver nitrate in its action in 50 per cent serum in 1 minute. Although too close a comparison must not be drawn between the action of a drug *in vitro*, where penetration is assured, with its action *in vivo*, where pene-

[1] Davis, D. M., and Swartz, E. O. The testing of germicidal substances against the gonococcus. J. Infect. Dis., 1920, xxvii, 591–601.

TABLE VII.—PROPHYLACTIC USE OF MEROXYL TO PREVENT CATHETER FEVER AND INFECTIONS

Patient	No.	Operation	Strength of solution	Frequency	Remarks
S. C.	5730	Perineal prostatectomy	0.5%	t.i.d. 4 days	In catheter (before oper.) and drainage tube (after oper.); urine was sterile at all times, and on discharge of patient.
O. P. H.	9970	Perineal prostatectomy	0.5%	t.i.d. 4 days	In catheter (before oper.) and drainage tube (after oper.); urine sterile at all times, and on discharge of patient.

In a few other cases, with urine sterile at the time of admission, similar measures did not keep it so.

tration, distribution of organisms and other variations must be considered, such a high experimental bactericidal value should justify the clinical trial of meroxyl.

CLINICAL EXPERIENCES WITH MEROXYL

Open infected wounds present excellent opportunities for studying their bacterial content, and on this account an effort has been made to investigate the germicidal value of meroxyl in such wounds. We have endeavored to do so, following as closely as possible the methods employed by Carrel, Dakin, and their associates.

Through the kindness of Dr. Halsted, a series of wounds in the surgical wards and in the surgical out-patient department of the Johns Hopkins Hospital has been studied bacteriologically. Dr. Wm. Rienhoff has had charge of the treatment of these cases. The treatment has usually consisted of irrigation with a 0.5 per cent meroxyl and the application of an ointment containing 1 per cent meroxyl. The clinical notes of twelve cases are given herewith in brief.

REPORT OF CASES IN WHICH MEROXYL WAS USED IN WOUNDS[1]

CASE 1. G-65782. Carbuncle of lower jaw with glands. Opened June 5, 1922; drained, irrigated well with meroxyl, 0.5 per cent. Next day again irrigated and dressed with meroxyl ointment. Count 25 bacteria per microscopic field.[2] Daily application of meroxyl sterilized wound in 3 days. Area healed in 3 weeks.

CASE 2. G-65873. Infected laceration of leg 1 week old; draining pus, count 8 per field, when irrigated with meroxyl 0.5 per cent and dressed daily with meroxyl ointment 1 per cent. Sterile in 5 days and healed in 11.

CASE 3. G-65591. Infected finger following splinter, with lymphangitis and axillary adenitis. Incised, drained. Irrigated daily with meroxyl 0.5 per cent and dressed with meroxyl ointment. Count dropped in 24 hours from 37 to 5 per field. Dressed with boric acid, and count rose to 18 per field. Then healed after 2 weeks.

CASE 4. G-64862. Infected finger. Incised and drained. Count before treatment over 100 per field. Ointment and solution used; wound drained pus. Dressings made every second day. In 18 days count 3 per field.

CASE 5. G-64453. Infected stump of amputated finger. Wound count at start 8 per field. Dressings every second day; drained pus. Wound count after 12 days 2 per field. Healed in 26 days.

CASE 6. G-64329. Infected finger. Dressed from May 8, 1922, to June 6, 1922, with boric ointment, etc. Wound count June 6, 1922, 10 per field. Sterilized in 9 days with meroxyl solution and ointment. Wound healed in 25 days.

CASE 7. G-64103. Palmar abscess 1 week old. Incised and drained every second day; meroxyl irrigations 0.5 per cent. Count June 24, 1922, 8.4 per field; count June 26, 1922, 2.6 per field. Sterile in 6 weeks; ointment also used.

CASE 8. G-61718. Palmar abscess and infection of tendon sheaths, postoperative. Persistent drainage with formation of exuberant granulations from April until May 20. Count May 27, 15 per field; count June 12, 1 per field after meroxyl treatment. Healed by June 27.

CASE 9. G-49127. Bone felon, operated. Count May 25, 1922, 15 per field; May 27, 1922, 2 per field; May 29, 1922, 3/10; healed June 12, 1922.

CASE 10. G-50354. Luetic ulcer, secondarily infected. Count May 23, 1922, over 100 per field; count June 22, 1922, 8 per field.

CASE 11. G-51331. Carbuncle of abdominal wall. June 16, 1922. Incised, drained; meroxyl irrigations and ointment. Sterilized by June 24, 1922, and healed 1 week later.

[1] Preparation of ointment: Two grams of the powder (containing 1 gram of pure substance) is dissolved in 10 cubic centimeters of hot water. The solution or the gel forming as the solution cools, is incorporated with 90 grams of lanolin by very thorough mixing. An even, permanent ointment results.

[2] In making wound counts the method of Carrel has been employed. Smears were fixed by heat, stained ½ minute with carbolthionin, washed in water, and examined with No. 10 ocular and 1.9 mm. oil immersion lens. Five fields were counted on heavily infected smears, 10 on moderately infected, and 20 on slightly infected smears. In the fractions used, the denominator indicates the number of fields counted, and the numerator the total number of organisms observed. Carrel, A., and Dehelly, G. The Treatment of Infected Wounds. Translation by H. Child. New York: Paul B. Hoeber, 1917, page 155.

TABLE VIII.—WET DRESSINGS OF WOUNDS WITH MEROXYL

Patient	No.	Operation	Strength of solution	No. of days	Remarks
Wm. B.	10076	Hypospadias (straightening of penis), 1st stage.	0.5%	16 days	Slight infection, rapid healing.
J. P. H.	10134	Varicocele	0.5%	8 days	Slight infection, rapid improvement.
D. M. C. C.	9952	Hypospadias (straightening of penis), 1st stage.	0.5%	12 days	Tiny stitch abscess. Healed quickly.
A. B.	9809	Carcinoma of penis. Radical operation.	0.5%	12 days	Mild ptyalism. Later dressings with 1:1,000 gave no reaction. Healed well.
C. W.	6944	Hypospadias, 3rd stage. Cure of small fistula.	0.5%	16 days	Slight infection, rapid healing.
Wm. G.	10143	Hypospadias (straightening of penis), 1st stage.	0.5%	12 days	Slight infection, rapid healing.
L. P.	10151	Carcinoma of penis. Radical operation.	0.5%	22 days	Some sloughing of skin edges. Dakin's for 10 days, then meroxyl. Satisfactory healing.
H. P.	10166	Carcinoma of penis. Radical operation.	0.5%	30 days	Some slight superficial infection; healed in 30 days.
G. R.	10180	Radical oper. for tuberculosis of genital tract.	0.5%	14 days	Very favorable healing.
C. R.	10185	Hypospadias (straightening of penis), 1st stage.	0.5%	9 days	Slight infection, rapid healing.
B. F. L.	10124	Hypospadias (straightening of penis), 1st stage.	0.5%	14 days	Small area of pressure necrosis from suture. Rapid healing.
G. H.	10345	Carcinoma of penis. Radical operation.	1:4,000	6 days	Dakin's irrigations after necrotic area appeared. Healing in 38 days.

It is obvious that all the wounds in this table healed uninterruptedly. Dakin's solution was used for a time in cases where quantities of necrotic tissue were present. A case of mild ptyalism was taken to indicate that a 0.5 per cent solution was somewhat too strong. A 1:1,000 solution is equally effective.

An analysis of the above series shows that in about 50 per cent of the cases the wound became sterile in from 3 days to 2 weeks, with the exception of one case which required 6 weeks, and in other cases the count dropped to from 1 to 5 bacteria per field, which is very low, according to the data obtained in army hospitals. Such cases could easily be operated upon or skin-grafted. While the above series is small, it is sufficient to show the bactericidal effect of meroxyl in tissues, and demonstrates also that wound healing is not impaired, and that epidermization is not interfered with. As a result of further experiences some of us are convinced that the drug may be used in distinctly weaker solution and that 0.5 per cent is not necessary to obtain sufficient germicidal effect. In a much longer series of wounds where it was impossible to carry out bacterial counts our clinical experience has been that badly infected wounds clear up under irrigations of meroxyl 1:1,000 very satisfactorily.

DISCUSSION

Meroxyl has also been used in the urological wards of the Johns Hopkins Hospital in a great variety of ways. Its great germicidal power and its non-staining and non-irritating properties, lead one to apply it frequently. These uses are classified in the accompanying tables, and may be discussed seriatim.

1. *Irrigation of infected kidney pelvis.* When an infected pelvis is opened at operation, it would seem that some means should be adopted to attempt to cure the infection while drainage is going on. It is often felt that ordinary pelvic lavage through a ureteral catheter fails because of the necessarily infrequent applications. Through a small tube laid in the pelvis at operation frequent lavage, or even continuous irrigation, can be carried out. This procedure has been adopted in three cases. In one case, diminution of pus and organisms was observed, but in the other two no improvement. A 1:1,000 solution of meroxyl was used. The most reasonable explanation of this failure is that the constant presence of a foreign body in the wound of the pelvis prevents sterilization. Further experiments must be made, however, before so promising a method is abandoned.

2. *Treatment of acute gonorrhœa.* In this series, a system of frequent injections (five times a day) was adopted. The patients used the solution at home, and were instructed to retain it in the urethra for 5 minutes. One-half of one per cent meroxyl was used. To the table as given should be added another recent case where an acute gonorrhœa was

TABLE IX.—IRRIGATION OF INFECTED WOUNDS WITH MEROXYL

Patient	No.	Operation	Strength of solution	Frequency	Remarks
Wm. C.	9987	Nephrolithotomy	0.5%	4 x d.	Wound infected from kidney. Opened for 2 inches. 24 days treatment. Healed in 40 days.
C. F.	9972	Peri-urethral abscess	1:4000	q. 3 h.	19 days. Healed in 37 days.
R. W. T.	1066	Sinus from infected kidney	1:1000	t.i.d.	Improved, not healed in 14 days. Nephrectomy later.
W. J.	1001	Urinary extravasation	1:1000	q. 2 h.	Dakin's for 10 days until gangrenous tissue had gone. Skin graft 13th day. Healing 50 days. Very good result.
G. C.	10082	Epididymectomy for tuberculosis bilateral.	0.5%	q. 4 h.	Healed well; sinus still present at discharge little drainage. 14 days.
F. G. W.	10105	Peri-urethral and prost. abscess.	1:2000	q. 2 h.	20 days. Rapid healing. Small sinus on discharge.
G. C.	9909	Nephrectomy for tuberculosis	1:1000	3 x d.	Wound broke down completely. Under irrig. healed up to 1¼ in. in 50 days.
M. L.	10089	Perineal prostatectomy	0.5%	4 x d.	Wound separated. Healed in 35 days.
O. McG.	9936	Nephrolithotomy	0.5%	q. 4 h.	Slight sore mouth 11th day. Had had same before oper. Changed to boric. Almost healed in 30 days.
E. O.	9914	Perineal prostatectomy	0.5%	3 x d.	Wound separated. Not yet healed in 40 days. Very indolent.
M. S.	9853	Nephrectomy for tuberculosis	1:1000	q. 3 h.	Wound broke down. Slight ptyalism. Healed slowly; 1 cm. long in 46 days.
J. T.	9888	Perineal prostatectomy	0.5%	3 x d.	Wound separated when repacked for hæmorrhage. Healed in 45 days.
L. T.	10010	Prostatic abscess	0.5%	q. 4 h.	Healed in 27 days completely.
A. T.	10262	Perineal prostatectomy	0.5%	3 x d.	Wound separated. Healed in 60 days.
F. J. M.	10203	Nephro-ureterectomy	0.5%	Once	Small abscess. Ptyalism and diarrhœa due to one too forceful injection.
M. W.	10193	Nephrectomy for tuberculosis	0.5%	t.i.d.	10 days. Received also Dakin's and ultra-violet light. Complete separation. No healing in 11 weeks.
A. C. S.	10494	Radical oper. for tumor of testicle.	1:1000	q. 4 h.	18 days. Also had Dakin's for 9 days at first. Wound badly infected. Healed in 36 days.
E. S.	10189	Nephrectomy for tuberculosis	0.5%	b. d.	20 days. 25 c.cm. followed by 150 c.cm. salt sol. through tube. Wound did not break down. Very satisfactory result.

It is difficult to draw definite conclusions from this table. Wounds breaking down after nephrectomy for tuberculosis are known to close very slowly. Under meroxyl the bacterial counts of these wounds were reduced, and they healed steadily if slowly. Other wounds healed favorably.

aborted by three injections in one day. In one case it was noted that shortly after an injection of meroxyl, no organisms could be found in the urethral pus, while they were still present in the pus in the third glass of urine, and the urethral pus became reinfected. Meroxyl is the most powerful gonococcicide available, but it is evident that it, like other drugs is unable to reach all the gonococci in many cases.

3. *Prophylaxis of urinary infection.* Meroxyl has been very freely used for irrigating catheters and drainage tubes, for instillations and irrigations before and after instrumentation, and for injection through ureteral catheters just before removal. It is our impression that a great many infections are so prevented, though statistics are difficult to gather. An instillation of meroxyl before and after the use of sounds has prevented chills in patients where they have invariably occurred on previous occasions. Two patients wearing retention catheters have been kept sterile for four days preceding operation by frequent irrigations with meroxyl.

4. *Wet dressings for wounds.* Wet dressings have been adopted for many wounds where infection was especially feared, as in hypospadias cases, where small uncovered areas or drains were present, when skin grafts were used, or where separation of the skin edges occurred. Where any necrotic tissue is present, Dakin's solution is preferable, as meroxyl does not dissolve the sloughs nor is it a deodorant. After the wound has become clean it is our practice to substitute meroxyl for Dakin's solution. It can be said that all the wounds treated with meroxyl healed uninterruptedly, and no spread of infection occurred.

5. *Irrigation of infected wounds.* In wounds where deep infection is present it is our custom to irrigate with meroxyl solution except, as mentioned above, where necrotic tissue is present, when Dakin's solution is preferable. Many of the wounds so treated were cases

TABLE X.—INSTILLATIONS OF MEROXYL FOR CYSTITIS

Patient	No.	Diagnosis	Strength of solution	Frequency	No. of days	Remarks
C. J. E.	9960	Chronic cystitis (interstitial?)	1:1,000	4 x day	86 days	No marked improvement in urine, but frequency and burning relieved. Also received hydraulic dilation.
J. H. J.	10120	Acute cystitis	1:1,000	4 x day	50 days	Improvement in urine, frequency and burning improved. Also received hydraulic dilation. Area of interstitial cystitis found before discharge.
W. E. H.	9820	Chronic cystitis	1:200	q. d.	14 days	Cured. Urine sterile on discharge.
S. N.	10009	Chronic cystitis	1:200	b. d.	6 days	Had bladder polyp removed. Urine sterile on discharge.
A. H.	9912	Chronic cystitis in paretic bladder	1:1,000	b. d.	12 days	Also received argyrol. Slightly improved; not sterilized.
E. B. G.	9004	Chronic interstitial cystitis, and diabetes	1:1,000 1:200	q. 4 h.	4 days	Also received argyrol and 220. No improvement. Death.
M. A. S.	9975	Chronic pyelitis and cystitis, diabetes	1:4,000	t.i.d.	6 days	No improvement. 220, 1% lavage to kidney. Pyelonephritis, death.
Wm. O.	9848	Chronic cystitis and contracted vesical orifice	1:200	t.i.d.	5 days	Punch oper. Great improvement at end of 5 days. Few wbc. and occasional coccus in urine.
A. H. A.	8517	Chronic cystitis and contracted vesical orifice	1:1,000	t.i.d.	4 days	Punch oper. Also received 220. Great improvement at end of 10 days. Some pus but no organisms.
J. C. F.	9768	Interstitial cystitis	1:4,000	5 x day	70 days	Also received hydraulic dilation. No improvement in urine.

This table includes various kinds of cystitis. No case of so-called interstitial cystitis showed any improvement not referable to hydraulic dilation. Ordinary chronic cystitis showed improvement.

where a tuberculous kidney had been removed, or where pus or infected urine had contaminated the incision. The results in general have been satisfactory, all non-tuberculous wounds healing uninterruptedly, Tuberculous wounds are kept clean, but the healing is not noticeably hastened. No retarding effect on granulations has been observed. There is never any irritation of the skin as with Dak'n's solution. In one case where an injection of 0.5 per cent solution was made too forcibly, pain and vomiting occurred but no unfavorable after-effects followed. In two other cases there was slight salivation after prolonged use of a 0.5 per cent solution. A 1:1,000 solution is entirely satisfactory and equal to 1:1,000 bichloride of mercury in germicidal value. All perineal prostatectomy wounds have been washed with 0.5 per cent meroxyl as a routine for some time. During this period 89 cases have been so treated, and in only four did the sutured portion of the wound fail to heal *per primam*. These all healed satisfactorily by second intention under a continuation of the irrigations, as did the drainage tracts in the other 85 cases.

6. Treatment of chronic cystitis. These cases divide themselves into two groups: the so-called interstitial cystitis, and ordinary chronic cystitis. No favorable effect was observed in the cases of interstitial cystitis, as was to be expected. Other cases all showed marked improvement or cure.

7. Treatment of postoperative cystitis. Cystitis almost invariably follows operations involving the bladder, and a method of treatment enabling one to overcome this complication would be a tremendous advance in urological surgery. The results in 36 cases treated with meroxyl are shown in Table XI. It should be stated that in many cases it was impossible to continue the treatment as long as desired since the patients, feeling quite well, wished to return home. In spite of this, however, the results were very satisfactory since, in a majority of cases, the urine, if not sterilized, was improved and often made macroscopically clear. In two of the six cases showing no improvement, diverticula were demonstrated in the bladder. In our clinic it is now not unusual to sterilize the bladder within a month after perineal or suprapubic operations.

We feel that meroxyl is an invaluable drug for the urologist, especially for its effects in preventing infection and in the treatment of cystitis. As an irrigation for infected wounds, it has proved its usefulness both bacteriologically and clinically. We have of course met with many failures to sterilize the urine in

TABLE XI.—INSTILLATIONS OF MEROXYL FOR POSTOPERATIVE CYSTITIS

Patient	No.	Operation	Urine before operation		Strength of solution	Frequency	No. of days	Urine before instillation		Urine after instillation		Remarks
			Pus	Organisms				Pus	Organisms	Pus	Organisms	
B. B.	10054	Perineal prostatectomy	+	+	1:1,000	t.i.d.	3 days	+++	++	+	—	Great improvement. Cure?
J. C. K.	10036	Perineal prostatectomy	++	++	1:1,000	t.i.d.	3 days	++	+	+	+	Improvement.
H. McC.	10018	Nephropexy	—	—	1:1,000	t.i.d.	1 day	++++	+	—	—	Cured.
J. W. S.	10000	Repair int. and ext. sphincter	+++	++	1:1,000	t.i.d.	10 days	++	++	+	few	Bacilli markedly reduced.
J. G. P.	10093	Nephrectomy (chronic pyelonephritis.)	++	++	1:500	4 x day	3 days	+	+	—	—	Cured.
A. W.	10045	Perineal prostatectomy	++	+	1:200, 1:1,000	5 x day	2 days	++	+	?	?	Left before specimen could be examined.
S. L.	10025	Perineal prostatectomy	+	+	1:1,000	q. 4 h.	11 days	+++	+	+	—	Clear on several occasions.
D. D.	10138	Perineal prostatectomy	+	++	1:1,000	4 x day	4 days	++++	+++	+	few	Frequency and burning disappeared.
C. A. N.	9978	Perineal prostatectomy	+++	+++	1:1,000	q. 4 h.	6 days	+	+	+	few b.	Also received 220 three days 1 per cent. Great improvement.
M. S.	9853	Nephrectomy for tuberculosis	++	+	1:1,000	q. 4 h.	3 days	+	few	Occ. wbc.	—	Cured.
M. W.	9537	Suprapubic prostatectomy			1:200	q. 3 h.	12 days	++	+	—	—	Persistent fistula and cystitis. Cure, fistula closed.
J. R.	10118	Perineal prostatectomy	+++	+	1:200	q. 3 h.	5 days	++	+	+	+	Marked improvement in gross appearance of urine.
C. H.	10047	Suprapubic lithotomy	++	+	1:1,000	q. 4 h.	3 days	++	+++	+	few	Marked improvement. Macroscopically clear.
W. M.	10031	Perineal prostatectomy	++	++	1:200	3 x day	3 days	++	+	+	Occ.	Marked improvement.
H. W.	10081	Suprapubic lithotomy Punch operation	+	+	1:1,000	q. 4 h.	1 day	+	Occ.	few	+	Epididymitis. instillations discontinued without improvement.
G. R.	10180	Radical operation for tuberculosis genital tract	+++	few	1:1,000	b. d.	14 days	++	Occ.	few	Occ. bac.	Frequency and burning disappeared. Some improvement.
N. K.	10126	Perineal prostatectomy	+	few	1:1,000	5 x day	5 days	++	+	very few wbc.	Occ. bac.	Great improvement.
T. T.	10091	Perineal prostatectomy	—	—	1:500	5 x day	4 days	++	+	few wbc.	Occ. bac.	Great improvement.
W. P. T.	0121	Perineal prostatectomy	++	+	1:200, 1:1,000	q. 3 h.	4 days	++	+	++	+	Frequency and burning disappeared. Also had 220.
W. J. C.	10206	Perineal prostatectomy	++	+	1:500	q. 4 h.	5 days	+	+	+	—	Great improvement.
A. T.	10262	Perineal prostatectomy.	few	+	1:500	5 x day	2 days	++	+	+	+	Some improvement.
Wm M.	10170	Perineal prostatectomy	few	—	1:1,000, 1:200	5 x day	7 days	++	+	+	Occ. bac.	Marked improvement.
J. B. C.	10023	Perineal prostatectomy (stones)	++	+	1:200, 1:1,000	q. 4 h.	4 days	++	+	++	very few	Some improvement.
J. F. E.	10022	Perineal prostatectomy	+	+	1:200, 1:1,000	4 x day	5 days	+	+	+	+	Urine not improved but dysuria cured.
J. Z. W.	10050	Perineal prostatectomy.	few	—	1:1,000	q. 3 h.	4 days	++	+	+	Occ.	Great improvement.
G. F. E.	10233	Perineal prostatectomy	+	+	1:1,000	5 x day	3 days	++	+	++	+	Epididymitis. No improvement.
J. J. J.	10168	Perineal prostatectomy	+	+	1:500	5 x day	6 days	++++	++	+++	+	Little improvement.
R. A. S.	10468	Perineal prostatectomy	few	+++	1:1,000 1:500 1:200	5 x day	3 days	++++	++	++ ++	++	No improvement. Cellules and diverticulum.
J. A. A.	10453	Perineal prostatectomy	++++	few	1:1,000, 1:500	5 x day	2 days	++	++	++	++	No improvement. Diverticulum.
J. B.	10450	Perineal prostatectomy	++	++	1:1,000, 1:500	5 x day	2 days	++	++	++	+	Some improvement. Bacilli decreased.
W. A. W.	10489	Perineal prostatectomy	—	—	1:1,000, 1:500	3 x day	2 days	+	++	+	Occ. bac.	Marked improvement. Cocci eliminated; only occasional bacillus.
F. H.	9650	Radical cure of epispadias	—	—	1:4,000	b.d.	15 days	+	+	—	—	Cured.
J. F.	10535	Perineal prostatectomy	—	—	1:1,000, 1:500	5 x day	2 days	+++	++	+++	Occ.	Marked improvement.
S. H.	10315	Perineal prostatectomy	++	++	1:1,000 1:500 1:200	5 x day	4 days	+++	+++	+++	+++	No improvement.
H. D.	10393	Perineal prostatectomy	+	++	1:1,000, 1:500	5 x day	2 days	+	+	+	Occ.	Marked improvement.
J. S.	10373	Perineal prostatectomy	+++	++	1:1,000 1:500 1:200	5 x day	4 days	+++	+++	+++	+++	No improvement.

This table shows mostly cases of cystitis after perineal prostatectomy. It will be seen that most of them were infected at the time of admission. The results may be classified as follows: Total cases, 36; cured (sterilized) 5 cases, 14 per cent; infection markedly improved 14 cases, 39 per cent; somewhat improved 10 cases, 28 per cent; not improved 6 cases, 16 per cent; no record 1 case, 2.8 per cent. Cured or improved 29 cases, 80 per cent. The technique finally adopted comprised 5 instillations a day, of about 30 c.cm. each. Each day of instillations is followed by a day of rest. The first day, a 1:1000 solution is used, the second, 1:500, the third and subsequent days, 1:200, unless too much irritation is caused, when one of the weaker solutions is resumed. In many cases atropin gr. 1/120 dissolved in a little water is injected 5 minutes before the instillation "to prevent reverse peristalsis of the vasa deferentia."

cystitis, but in some of these cases deep-seated infection of prostate, seminal vesicles or kidneys was present, while in others diverticula or cellules harbored the organisms. At present we seem to get the best results in cases with prostatic infection by irrigating the bladder by hydraulic pressure without a catheter with 1:2,000 meroxyl, and then injecting the urethra and bladder with 0.5 per cent mercurochrome. Prostatic massage two or three days later will usually show the cells stained deeply pink.

MEROXYL IN OTHER SPECIALTIES

We have furnished meroxyl in considerable quantity to specialists in other lines of work, particularly in otolaryngology and ophthalmology, and from time to time have had reports indicating very satisfactory results. Dr. Samuel J. Crowe has given us the following report of the experience with meroxyl of the department of otolaryngology of the Johns Hopkins Hospital:

Since the introduction of meroxyl in January, 1921, this antiseptic has been largely used in treating affections of the ears, nose and throat in the Johns Hopkins Hospital and dispensary.

We feel that the value of this drug has been clearly demonstrated. For most purposes it is superior to the silver preparations and is equally as good, if not better than its predecessor, mercurochrome. The latter is preferable in cases where penetration is especially desired; but the fact that meroxyl does not stain and is at the same time more germicidal than mercurochrome renders it the solution of choice in treating the nose and ears. Silver nitrate is almost indispensable in this special field of surgery but we find that better results are often obtained when meroxyl is used in conjunction with this drug.

We give below a few isolated cases in which we have obtained excellent results with meroxyl:

In chronic suppurative otitis media in which there is a large perforation in the drum, we have often been able to clear up the discharge temporarily, but as there is almost always an infection of the mastoid, nothing short of an operation really cures the condition. In these cases the best results are obtained by filling the ear with a 0.5 per cent or even weaker solution and then catheterizing the Eustachian tube and passing a whalebone bougie. When this is withdrawn, it draws some of the solution down the tube. The meroxyl can also be injected into the catheter and forced up the tube into the middle ear. We have been able to clear up one case of subacute suppurative otitis media in which the drum had been incised on five occasions, a hæmolytic streptococcus being present. The clinical examination and the X-ray showed a definite infection of the mastoid, although there had been no previous trouble. In this case, following a paracentesis of the drum, the Eustachian tube was dilated and about an ounce of the 0.5 per cent solution was forced up the tube. About a week later the ear had healed and the hearing was normal.

In a few cases of chronic maxillary empyema where the sinus is not filled with polypi, we have been able to stop the discharge by instilling a little 0.5 per cent meroxyl into the antrum after the pus had been washed out with salt solution. In one recent case with an acute antrum infection the condition seemed to clear up quickly after one instillation of 0.5 per cent meroxyl. So many of these cases clear up, however, after a very few irrigations with sterile normal salt solution that it is impossible to arrive at any definite conclusions as regards the acute cases. After operations on the various sinuses we have found meroxyl most useful, either by local application or by instillation through a metal catheter.

On several occasions we have been able to abort an attack of acute rhinitis or pharyngitis by the local application of 0.5 per cent – 1 per cent meroxyl in the nasopharynx and pharynx. In the former condition this is best applied along the floor of the nose. If the cases are treated within 10 to 12 hours after the onset, the results are most favorable. It has been the personal experience of several members of the staff with acute pharyngitis that almost immediate relief is obtained as regards swallowing after a generous local application to the pharynx.

We have not noticed that meroxyl is superior to the other antiseptics in the treatment of acute tonsillitis. It is more soothing than silver nitrate, however, and is probably as good as any.

A very stubborn case of retro-tonsillar abscess which came on about a week after tonsillectomy was seen recently. The operation had been performed elsewhere about three months previously and when first seen there was a deep-pocketed abscess. This did not clear up quickly as they often do after wide incision, but after irrigating a few times, once a day, with 1 per cent meroxyl a cure resulted. The organism in this case was a hæmolytic streptococcus.

These are just a few of the cases in which the results have been most satisfactory. We feel that much more can be accomplished if careful studies are made as to the bacteriology and as to the proper strength of solution to use in the various situations with reference to the stage of the infection.

Dr. James Bordley reports in a personal communication that the drug has been efficient in curing several middle ear infections, results which, he recently stated, were quite unusual and which will be reported in detail in a separate paper.

No systematic experiments on the use of meroxyl in the sterilization of diphtheria carriers and other throat infection have as yet been carried out. From our present experience we feel safe in saying that this drug is of value in treating infections of the ear, nose and throat and probably also the eye and in dentistry. The question of the penetration of the drug, which cannot be definitely demonstrated as it can in the case of mercurochrome, is of utmost importance. Meroxyl is undoubtedly a germicide of greater potency than mercurochrome, and therefore probably more effective when the bacteria can be reached by local applications and irrigations; nevertheless the question arises whether mercurochrome or other antiseptic dyes may not be more effective in reaching deep-seated infections, sinuses, glands, etc.

RÉSUMÉ

Further discussion is scarcely necessary as the bactericidal and clinical qualities of meroxyl have been fully enumerated before. It may be well, however, to state here that the fact that antiseptics are now available which show little or no inhibition by serum or urine, is of the greatest importance, and urologists in particular should, in our opinion, seize the opportunity to make use of antiseptics in a prophylactic way far more extensively than in the past. Prevention is the most important field in medicine and nowhere is it more urgently necessary than in urology where such dire results follow urethral, prostatic, bladder, and renal infections which come, only too often, from the common clinical instrumentations and examinations. In our short series of cases we have demonstrated that catheterization even for prolonged periods can be carried out without vesical infection, and that prostatectomies can be brought through to complete healing without infection of the bladder. This, we believe, has not hitherto been accomplished, at any rate, it has not been spoken of in the literature. When we compare the healthful wound conditions now customary in our wards with the distressing infections, often complicated by depositions of urinary salts and by tissue necrosis, which used to be so common, we feel justified in asserting that a new epoch has been opened. When by simple pre-operative and postoperative injections of the urethra, instrumental infections can be effectively prevented, it will become little short of criminal to be indifferent to commonly recurring instrumental infections in a urological service. It is now no uncommon thing to subject a patient to numerous cystoscopies, ureteral catheterizations, functional tests, pyelograms, and operations to remove calculi from the kidney or ureter, the wound being drained, without having an infection either of the urinary tract or of the drained wound during the convalescence.

The details of the technique and the selection of the solution strength for meroxyl in the treatment of wounds and inflamed mucous surfaces have as yet not been fully established. In all probability it can be used effectively in weaker solutions than we have ourselves employed. It is certain that the 0.5 per cent strength is not necessary in urethral and bladder work, although it can be readily used for a limited number of applications. In the same way the frequency of irrigation and other details have not been thoroughly worked out, nor has it been decided which cases can be more satisfactorily handled with meroxyl than with Carrel-Dakin solution or with other standard antiseptics. Sufficient, however, has been done to warrant us in stating that an antiseptic of pronounced value has been produced, for which the prospects of future usefulness in more extended fields are very bright.

CHOLECYSTITIS AND ITS COMPLICATIONS[1]

By M. G. PETERMAN, Sc.B., A.M., M.D., Rochester, Minnesota
Fellow in Surgery, 1921–1922

THIS study of biliary tract infections has been made with an idea of attempting to clear up certain disputed points in the pathogenesis of cholecystitis and its complications. Some of the experimental work has followed lines that were not new, in the hope, however, that additional light might be thrown on conceptions which at present are in a state of some confusion. Probably the chief value contributed by this report is the emphasis which it places on the importance of the lymphogenous route, not only in the pathogenesis of the complications of cholecystitis, but also in the pathogenesis of cholecystitis itself. New evidence is submitted which indicates that this route is of much greater importance than it has usually been considered to be. The significance of infections of the portal system in general, in relation to cholecystitis, is also sharply portrayed in some of the experimental work. For convenience, this report is considered in six parts. Part I consists of a review of the literature on experimental cholecystitis; in Part II is submitted the experimentation directly concerned with the establishment of experimental cholecystitis and its relation to hepatitis; Part III contains a consideration of cholecystitis in its relation to appendicitis and ulcer; Part IV consists of a review of pancreatitis and its relation to cholecystitis with a report of investigation; in Part V a survey of clinical cases is offered, and Part VI is a general discussion.

Part I

When Louis (1) actually demonstrated, for the first time, the association of gall-bladder changes with typhoid fever, he prepared the way for experimental cholecystitis. About 30 years later (1861), Rokitansky (2) again drew attention to inflammation of the biliary tract in "typhus fever." Hagenmueller (3) then focused attention on this subject by submitting the first monograph on typhoid fever. The discovery of the bacillus typhosus by Eberth (4 and 5) and the confirmation of this discovery by Koch (6) then kindled the enthusiasm which produced, in the following years, the great number of contributions to our present knowledge of gall-bladder disease. Thus it is easily understood how earlier investigation was confined so closely to infections with the typhoid bacillus.

Exceptions to experimentation with bacterial infection are to be found in the reports of those investigators who were at this time (1881) studying the liver. Beloussow (7) in studying cirrhosis, noted, after ligation of the common duct in animals, that the normal golden yellow bile was changed to a pale viscid fluid containing epithelium and necrotic tissue; while the gall bladder was distended, the walls thinned out, but was free from organisms. Netter (8), in Paris, confirmed these observations, stating that ligation of the common duct in animals was followed by acute inflammation of the biliary passages.

Returning to typhoid cholecystitis, Gaffky (9) was probably the first to experiment on animals with typhoid in pure culture. Wyssokowitsch (10), soon after (1886), injected various organisms, including typhoid, intravenously into animals and recovered the organisms in the liver, portal lymphatics, milk, etc. His work was followed by a report of the Fuetterers (11). These men injected bacillus pyocyaneus into the left ventricles of rabbits and recovered this organism in the gall bladder 1½ hours later. Beumer and Peiper (12) experimenting on mice, rabbits, and guinea pigs, injected bacillus typhosus intraperitoneally and intravenously. They concluded that the organisms were transmitted everywhere by the blood stream but that they did not increase greatly in numbers and did not produce the pathology typical of typhoid in the human. Belfanti (13) disagreed, however, and stated that if a sufficient number of bacillus typhosus are injected into animals, the resulting picture is typical of, or similar to, typhoid fever in the human.

[1] From the Department of Surgery, Washington University School of Medicine. Presented to the Board of Graduate Studies in partial fulfillment of the requirements for a Master's degree in the Department of Surgery.

American investigators now became interested in typhoid cholecystitis and the works of Blachstein and Welch, of Johns Hopkins, appeared. Blachstein (14) stated that the intravenous injection of typhoid organisms into rabbits was followed by a "chronic affection of the gall bladder," and recovery of the organisms in the gall bladder. He did not mention his percentage of positive results. Welch (15), also injecting bacillus typhosus intravenously into rabbits, produced the same results but stated that only 50 per cent of his inoculations were successful. Charrin and Roger (16), of France, now varied the procedure somewhat and injected bacillus coli into the common duct. After 8 days they found the gall bladder full of pus with disseminated abscesses in the liver. The more virulent organisms produced pericholangeitis with abscesses in the liver.

In 1892, Naunyn (17) published his monumental work, "Klinik der Cholelithiasis." He was the first investigator to demonstrate the pathogenicity of bacillus coli. Injecting this organism into dogs, intravenously, he recovered the bacillus in the gall bladder at autopsy. Naunyn's work marks the new era of cholecystitis when the attention of medical science was centered on gall stones. Labes (18), working in Naunyn's laboratory at Koenigsberg, placed in the gall bladders of dogs various irritative substances (chemicals, quartz, human gall stones, etc.) but never produced gall stones. In his report, he stated that foreign bodies placed in the gall bladder disappeared, and he concluded that gall stones could not be produced experimentally. In this view he was supported by Naunyn. The error of this conclusion was soon demonstrated when Gilbert (19) produced, in the year following the publication of Naunyn's book, the first experimental gall stones. With Dominici (20), Gilbert also reported, in the same year, concretions found in the gall bladders of rabbits with experimental cholecystitis. Hartmann (21) claims priority of discovery for Mignot who, he says, was the first to present definite evidence of experimental gall stones when he read his paper to the Société de Chirurgie on May 19, 1897, demonstrating three stones from the gall bladder of a guinea pig suffering with experimental *bacillus coli cholecystitis*. In this connection it is interesting to note that Mignot himself published his thesis in 1896, in which he stated that he had produced definite, stratified gall stones, concluding that he required for their production an attenuated organism and 6 to 8 months' time. Gilbert preceded Mignot by 3 years and followed his original work with extensive proof. In 1894 he presented, with his co-worker Dominici (23), more experimental evidence and stated that cholecystitis was usually caused by bacillus coli. Four years later he proved the infectious etiology of cholelithiasis (24). He produced, also, a stone from the gall bladder of a dog, following inoculation with bacillus coli. At about this time, Cushing (25 and 26) produced experimental gall stones by inoculation of bacillus typhosus in the gall bladder of rabbits with "maltreatment" of the organ.

It was now that the fate of organisms following their introduction into the body was taken up with new interest. G. Fuetterer recovered staphylococcus aureus in the bile 40 minutes after subcutaneous injection. (The previous experimentation by the Fuetterers (11) was not directly concerned with the earliest time of appearance.) Homén (28) ligated the common duct of rabbits 1 to 2 centimeters above the ampulla and injected bacillus typhosus in the lower third of the duct, below the ligature, producing cholecystitis. The organisms were recovered from the liver. Sirotinin (29) reported the results of very extensive investigation, stating that he had recovered bacillus typhosus in the lungs, liver, and other organs, following experimental injection of this organism into rabbits and guinea pigs. He concluded that the pathological picture produced by this injection was caused by intoxication and was not due to a specific action of the organism. Biedl and Kraus (30), contributing a large amount of experimentation, studied the elimination of injected bacteria by the kidney, liver, and salivary glands. They recovered the staphylococci in the bile 13 to 45 minutes after intravenous injection. G. Fuetterer (31) now reported the results of very exact determinations and proved that bacillus prodigiosus

could be recovered from the bile 2 minutes after portal vein injection. Pawlowsky (32), commenting on a number of reports, believed that the organisms entered the gall bladder from the liver in the blood stream.

A short while ago, a report from this laboratory (33) stated that cholecystitis could not be easily produced by simple injection of organisms into normal gall bladders. Confirmation of this statement is found in the previous work of Ehret and Stolz (34). These investigators injected staphylococci into otherwise intact gall bladders and produced no lesions. They also introduced virulent bacillus coli into the gall-bladder wall causing little or no inflammation, or in their words, "*so war doch von eitriger Cholecystitis absolut nichts festzustellen.*" After injecting organisms intravenously and subcutaneously without results, they ligated the cystic duct and repeated the intravenous injection. This procedure gave definite results and a cholecystitis was produced. Also, after placing quartz stones in the gall bladder, and injecting organisms intravenously, they produced lesions in the gall bladder. These men concluded that both stasis and infection were necessary to produce cholecystitis. That those factors play a major rôle in the causation of gall-bladder disease cannot be doubted. However, the evidence offered by Blachstein and Welch together with the numerous reports and the experimental work submitted later offer crucial evidence that cholecystitis can be produced by intravenous injection without stasis of bile or traumatism of the gall bladder, provided the strain of organism used is of sufficient virulence and is injected in large enough amounts.

Ehret and Stolz (35) in another, a very exhaustive report, present an excellent review of the early literature and offer unquestionable proof that the mere injection of organisms into the normal gall bladder will not usually cause cholecystitis. They say in their report that the biliary tracts of guinea pigs and rabbits, and especially those of dogs, have the ability, provided they do not suffer any other involvement, to easily overcome any not too virulent infection—direct or indirect—within a short time. Such a statement is properly qualified. The virulence of the organism, and, it might be added, the number of organisms determine the question of infection. From the same paper: "The fact that micro-organisms could pass through the liver and other organs in large numbers was first demonstrated, for the 'Rotzbacillus' by Ferraresi and Guanieri; for the staphylococcus, pneumococcus, bacillus Friedlaender cholera vibrio, and bacillus typhosus by Corrado, Nicati, Oemler, Strauss and Chamberland, Oreste, Pernice and Olassi, and Bernabei. Among the earliest investigators on gall-bladder and liver reactions, following experimental procedure, were Charcot and Gombault who ligated the common duct in rabbits and guinea pigs and noted that inflammation of the biliary tract followed, and later, cirrhosis and other changes in the liver. Chambard, Foa and Salvioli, Beloussow, Canalis, Cholmogorow, Lahousse, and Pack carried out similar experiments and obtained similar results . . ." (see 34). Ehret and Stolz ligated the cystic duct twice and cut between the ligatures. They then produced cholecystitis by injecting organisms into the gall bladder. They observed that the organisms first increased in number, then decreased until the gall bladder became sterile. They also noted that foreign bodies introduced into the gall bladder produced stasis which predisposed to infection. These conclusions have been definitely established. Regarding the disappearance of organisms from the gall bladder it is interesting to note the report of Brioni and Kayser (36). They injected three-quarters to 1 cubic centimeter of a saline suspension of pneumococcus into the gall bladders of dogs. After several days they found that the organisms had disappeared from the gall bladder, but were still to be found in the blood. Forster and Kayser (37) were the first to prove that the gall bladder may be a source of infection in chronic typhoid carriers. They reiterated the now established fact that bacillus typhosus injected intravenously can be recovered from the gall bladder. These men also performed the experiments on immunized rabbits and obtained the same results. Doerr (38) now repeated the experiments of Ehret and Stolz, and reported that, following ligation of the

cystic duct, intravenous injection of typhoid bacilli produced no results. After ligation of the common duct, intravenous injection of typhoid produced a cholecystitis. Without ligation, he recovered bacillus dysenteriæ in the gall bladder after intravenous injection. In the light of both previous and subsequent, more careful and exact determinations, Doerr's negative results after ligating the cystic duct may certainly be disregarded. Either his experiments were too few or his observations faulty. Supporters of the descending theory of infection find comfort in Doerr's report. Chiarolanza (39), 3 years later, repeated the experiments of Doerr and recovered typhoid bacilli in the papillary folds of the gall-bladder mucosa following subcutaneous injection of bacillus typhosus.

Following a thorough review of previous literature, Chiari (40) concludes: "Cholecystitis is an hæmatogenous infection to the liver and the bile then infects the gall bladder; bacillus typhosus is regularly found in the bile of typhoid patients (exceptions being rare); the organisms may produce varying degrees of inflammation of the biliary tract; bacillus typhosus may be found inside of gall stones." Chiari's theory of the etiology of cholecystitis was, however, purely a theoretical one. The work of Chiarolanza followed by a report of Koch is much more conclusive. Koch (41) demonstrated, in sections, clumps of bacteria, capillary emboli, in the submucosa and wall of the gall bladder of a man dying of typhoid fever. He concluded that cholecystitis was caused by direct extension, probably meaning through the blood vessels. Meyer, Neilson, and Feusier (42) have recently made an exhaustive study of experimental infections of the gall bladder, particularly with reference to typhoid fever. They consider that the findings of Koch and Chiarolanza of bacterial emboli in the wall of the gall bladder during typhoid to be "exceptionally rare" and concerned with an "exceedingly severe and unique form of typhoid cholecystitis," and they state that an examination of human gall bladders in the cases of death from typhoid shows a capillary embolism only occasionally. These writers also make the important statement that, in order to have bacteria pass through the liver into the bile, it is necessary to have actual inflammatory lesions of the liver; and they add: "the conception of a purely mechanical passage deserves little consideration." It is significant also that both Wyssokowitsch (10) and Blachstein (14) considered liver necrosis as pre-requisite for the infection of the biliary passages in typhoid.

As the gall bladder has now been proved a source of infection in typhoid carriers, numerous investigators endeavored to reach this focus for therapeutic and prophylactic treatment. Conradi (43) produced chronic typhoid carriers in rabbits, and then claimed to have sterilized them with daily doses of chloroform (in milk or oil) by mouth and rectum. Hailer and Rimpau (44) produced experimental cholecystitis by intravenous injection of bacillus typhosus into animals and attempted then to sterilize or rid the animals of the organisms by rectal and oral administration of various drugs. They found methyl iodide and ethyl bromide most efficient. Marxer (45) placed in the gall bladders of dogs, corks soaked in broth cultures of typhoid, producing typhoid carriers. He then endeavored to sterilize the gall bladders by feeding various drugs by mouth. One dog showed positive cultures after four years. Marxer's work was very thorough and his conclusion, that sterilization of the gall bladder by means of drugs administered by mouth is impossible, is accepted today.

Metchnikoff and Besredka (46) now disproved the earlier conclusions of Beumer and Peiper, and Sirotinin, and demonstrated that human typhoid fever could be reproduced in animals (chimpanzees) by feeding them excreta from typhoid patients. Johnston (47) repeated the reproduction of chronic carriers in rabbits by intravenous injection of typhoid organisms. Cholera vibrios were again demonstrated in the gall bladder following intravenous injection by Baroni and Ceaparu (48), Grieg (49), and Cano (50). Then, following a report by Morgan (51), in which he stated that, after intravenous injection, he recovered bacillus typhosus from the gall bladders of only two of the twelve rabbits injected, appeared the work of Gay and Claypole (52). These careful investigators, in an excellent

series of experiments, produced chronic carriers in 76 per cent of the rabbits injected intravenously, and found cultures from the gall bladder more uniformly positive than those from the blood. "Characteristic lesions" of the gall bladder were also found. Hailer and Ungerman (53), and Uhlenhuth and Messerschmidt (54), apparently not accepting the investigations of Ehret and Stolz, reported the production of chronic carriers and chronic inflammation of the gall bladder in rabbits by direct injection of bacillus typhosus into the gall bladder. Hailer and Ungerman stated that the organisms were recovered from the gall bladder regularly up to 31 days after injection and in one case 217 days after injection; and that the chronicity or duration of the infection in the gall bladder was dependent upon the severity of the process. There can be little doubt that these men produced chronic cholecystitis by this method. However, the question of the extent of coincident traumatism of the gall bladder at operation presents itself. Hailer and Wolf (55) also demonstrated bacillus typhosus in the gall bladder following intraperitoneal, as well as intravenous, injection.

A revival of medical treatment of cholecystitis found its inception with the advent of vaccine therapy. Nichols (56), in a contribution from the United States Army laboratories, concluded that intravenous injection of organisms does not produce routine infection of the gall bladder; that vaccine therapy does not cure gall-bladder disease in rabbits; and that gall-bladder studies in rabbits are not suitable for determining immunity in man. Cummins and Cumming (57) also reported that vaccines have no effect on bacillus typhosus in the gall bladder and liver. The logical treatment of clinical cholecystitis was offered by Mayo (58) when he stated that excision of the gall bladder meant removal of the source of infection. Until the recent claims of Lyon (59), medical treatment of gall-bladder disease had been practically discarded in favor of surgery.

The investigations of Rosenow offer a fitting chapter to close the question of experimental cholecystitis by intravenous injection (systemic). He isolated "specific streptococci" from cases of human cholecystitis. These organisms he injected intravenously into rabbits and produced lesions in the gall bladder in 80 per cent of the animals (60). Whether or not this rather high percentage is explained by a specificity remains to be proved. The work of Rosenow is of particular significance, however, because it marks the establishment of hæmatogenous infection as the explanation of the etiology of cholecystitis for a certain percentage of cases. In spite of the numerous previous proofs of blood-stream infection, and of unquestionable negative results following introduction of organisms by mere injection into the gall bladder, Chiari (40), Girode (61) and Létienne (62), with the majority of investigators, accepted and championed the theory of descending infection of the gall bladder from the bile. In 1915 Rosenow (63) insisted that appendicitis, gastric and duodenal ulcer, and cholecystitis were embolic infections from some distant focus by "specific" organisms, especially streptococci, rather than that they were caused by descending, lymphatic, or contiguous infection. In the following year he submitted considerable experimentation (64) and concluded: "The simultaneous occurrence of lesions in the gall-bladder and in the cystic and common ducts following injection of the streptococcus from the gall bladder where these structures were involved, indicates that the lesions may be due to a wide range of affinity of the infecting micro-organisms. The occurrence at the same time of cholecystitis and pancreatitis in the animals injected with bacteria from acute cholecystitis and pancreatitis, and with strains from chronic cholecystitis and from ulcer after animal passage, suggests that the simultaneous presence of the diseases in the same patient is due commonly, in the beginning to hæmatogenous infection, and not so often lymphogenous or local invasion as the findings at operation so often appear to indicate." At about this same time, Nichols (65) reported an extensive investigation which he interpreted as evidence in favor of the descending theory of infection. He stated that micro-organisms enter the bile from the liver if they are present in the blood in

sufficient numbers, that not more than 50 per cent of the injections, however, are followed by positive cultures from the bile, that the organisms are recovered in ½ to 2 minutes after intravenous injection in rabbits; and, finally, he was convinced that experimental typhoid cholecystitis in rabbits was a descending infection in the bile. Schoebl (66) now reported that he recovered cholera vibrios from the gall bladder following intravenous injection by that they produced no lesions in the gall-bladder wall. Lange and Roos (67) injected typhoid organisms directly into the gall-bladder wall of rabbits. They stated that the organisms were recovered in the ear veins in 1 to 2 minutes after injection and disappeared from the circulation after 30 to 60 minutes.

Among the recent contributions to experimental cholecystitis are the report of Mann, from Rochester, and a paper from this laboratory. Mann (68) demonstrated the production of an acute specific chemical cholecystitis by the intravenous injection of Dakin's solution. The fact that a solution of sodium hypochlorite of a certain percentage and in sufficient amount should exert a specific action on the gall bladder in a high percentage of injections (highest in dogs) is striking. The report from this laboratory (33) appeared in January of this year. Experimental cholecystitis was regularly produced by injection of organisms into the lumen of the gall bladder after ligation of the cystic duct and vessels. An associated hepatitis was constantly present. The importance of lymphogenous infection of the gall bladder from the associated hepatitis was demonstrated.

CONCLUSIONS

A study of the literature seems to justify the following conclusions:

1. Intravenous injection of organisms, if in sufficient amount, is always followed by the appearance of these organisms in the bile. The organisms are probably carried to the liver in the blood stream, excreted in the bile, and carried through this medium into the gall bladder. Also, however, organisms are carried at the same time, among other places into the wall of the gall bladder by the blood stream and lymphatics.

2. The intravenous injection of virulent organisms in sufficient amount produces a cholecystitis in a high percentage of cases.

3. The organisms, after intravenous injection, may be demonstrated in the bile ½ to 2 minutes after injection and may be found in the gall bladder after the blood has become sterile.

4. Simple injection of organisms, even in large amounts, into the lumen of a normal gall bladder, does not usually produce a cholecystitis.

5. Injection of virulent organisms into the lumen of a gall bladder in sufficient amounts, after ligation of the cystic duct and vessels, regularly produces a cholecystitis.

6. Although cholecystitis may be due to an hæmatogenous infection, it is not infrequently lymphogenous in origin.

7. Cholecystitis is constantly accompanied by a hepatitis. The character of the lesion in the liver is determined, to a certain extent, by the origin and course of the disease in the gall bladder.

Accepting these conclusions as reasonably established facts, there still remain numerous problems for further consideration. Among those problems the following were considered of sufficient importance to warrant investigation: (1) The passage of organisms into the bile of the gall bladder after injections into the portal and systemic veins, as influenced by ligation of the cystic duct and vessels; (2) the occurrence of organisms within the wall of the gall bladder at a distance from the mucosa soon after portal-vein injections after preventing their descent in the bile by ligation of the cystic duct and vessels; (3) a study of the complications of cholecystitis produced experimentally.

PART II

EXPERIMENTAL CHOLECYSTITIS AND HEPATITIS

Since a considerable part of this investigation was concerned with the relationship between cholecystitis and hepatitis, and since there is a constant relationship between these two lesions, they are considered together. A brief review of the meager early literature on this subject forms the most fitting introduction to the experimentation.

As mentioned in Part I, Charrin and Roger (16) first reported the association of experimental cholecystitis and hepatitis following the introduction of organisms into the common duct. This method of procedure, of course, constituted direct infection of the liver. Following this report very little mention of the association of the two lesions was made in experimental studies.

In clinical medicine, however, we find that the relation was observed early. Riedel (69), in 1888, reported an enlargement of the right lobe of the liver in cholecystitis which is now designated as Riedel's lobe. Naunyn (17) states that Charcot was the first observer to report this relationship. Naunyn himself considered the association frequent in cholelithiasis. Grube and Graff (70) considered that hepatitis was not uncommon in cases of gall stones. Kehr (71) felt that the percentage of liver involvement was about 15 or 20 per cent in cholecystitis. Quincke (72) considers enlargement of the liver in cholelithiasis the rule, while Rolleston (73) does not regard the association as a frequent one.

It remained for Graham (74), however, to show that hepatitis is a constant accompaniment of cholecystitis, and subsequent work under his direction and supervision fully established this fact (33). A report of this investigation demonstrated that (1) the experimental cholecystitis was constantly accompanied by a hepatitis; (2) this hepatitis consisted, as previously pointed out by Graham, of a periportal or interlobular infiltration of leucocytes; (3) the same organism was isolated from both the liver and gall bladder; (4) infections of the gall bladder by the lymphatic route are easily produced. Attention is again directed to the excellent description of the lymphatics of the gall bladder which has been written by Sudler (75) and of the liver which has been written by Mall (76).

Investigation was now begun on the problem of recovery of organisms in the gall-bladder bile following intravenous (systemic) and portal vein injections, with and without ligation of the cystic duct and vessels; and, also, on the production of experimental cholecystitis.

EXPERIMENTS

Series A. Portal vein injections and cultures of bile. Normal rabbits of medium size were used. In 20 animals the following routine was carried out: anæsthetization; sterilization of the skin, and median line laparotomy with exposure of the portal vein. Three cubic centimeters of 24-hour broth culture of staphylococcus albus was injected into the portal vein. Three minutes after injection 1 cubic centimeter of bile was taken from the gall bladder (through the seared wall) and plated on agar media (plain and blood). Immediately thereafter 1 cubic centimeter of the heart's blood was taken (through a seared surface) and plated on agar media.

In 15 of the 20 rabbits, positive cultures of staphylococcus albus were demonstrated in the bile from the gall bladder. In all 20 the heart's blood was positive for the same organism.

Series B. Same as above except for previous ligation of cystic duct and vessels. In a second set of 20 rabbits, the operative routine of Series A was repeated and, in addition, the cystic duct and vessels were ligated. The portal vein was then immediately injected with 3 cubic centimeters of staphylococcus albus as before. Three minutes later cultures of the bile and of the heart's blood were obtained as above. All 20 of the rabbits showed positive cultures of staphylococcus albus in the heart's blood, while the gall-bladder bile was negative in every instance.

Series C. Portal vein injections after ligation of cystic duct and vessels 10 days previously. Ten rabbits were used. The procedure consisted of two stages. At the first stage, the animals were prepared in the usual way and the cystic duct and vessels ligated. The abdomen was now closed and the animal returned to the observation room. Ten days later the abdomen was again opened (with the same aseptic precautions) and the portal vein was injected with 3 cubic centimeters of 24-hour broth culture of staphylococcus albus. After 3 minutes the gall-bladder contents and the heart's blood were collected as above. The organisms were recovered in the gall-bladder contents in 6 of the animals and in the heart's blood in all.

Of the four negative gall bladders, 2 were gangrenous, and one small, white, and contracted. They were not studied in section.

Series D. Injections into ear veins. Five normal rabbits were used. Three cubic centimeters of 24-hour broth culture of bacillus coli were injected into the ear vein of each. The heart's blood and gall-bladder bile were collected and plated aseptically 3 minutes after injection. The heart's blood was found positive in 4 animals; the gall-bladder bile in 3.

Series E. Injections of virulent organisms into ear veins. Two and one-half cubic centimeters of virulent culture of bacillus coli were injected into the ear veins of each of 5 rabbits. These animals were killed 7, 8, 8, 9, and 11 days respectively after injection. The heart's blood was sterile in all 5 animals. In 4 the gall-bladder bile was found to contain bacillus coli. Positive lesions in the gall bladder were found in 3 rabbits. The cholecystitis was acute and involved the entire wall. The walls were œdematous, hæmorrhagic, and showed recent adhesions to the liver.

Series F. Production of cholecystitis by portal vein injections. Seven normal dogs were used, and the following routine was carried out: After anæsthetization and preparation of the skin, a median-line incision was made. The portal vein was exposed at its origin. Four to 6 cubic centimeters (depending upon size of animal) of virulent staphylococcus aureus (24-hour broth culture) were injected into the portal vein, and the abdomen closed. These animals were observed daily and were killed at various intervals of from 2 to 6 days and then autopsied. In 3 animals, no apparent lesion followed the first injection, and a second injection of hæmolytic streptococcus (2 cubic centimeters) was given. This produced a definite cholecystitis. A description of the lesions found at autopsy is given in the protocols.

PROTOCOLS OF SERIES F

Dog 4. Five cubic centimeters staphylococcus aureus and second injection 2 cubic centimeters hæmolytic streptococcus. Killed 2 days after second injection.

Autopsy. Liver: no gross lesions. Microscopic—acute hepatitis, general infiltration red blood cells. Gall bladder: wall greyish pink, adhesions to liver. Microscopic—severe acute inflammation throughout entire wall: marked infiltration of leucocytes. Mucosa well preserved.

Dog 5. Five cubic centimeters staphylococcus aureus and (second injection) 3 cubic centimeters hæmolytic streptococcus. Killed 3 days after second injection.

Autopsy. Liver: slightly œdematous and dark in color. Microscopic—general acute hepatitis with infiltration: most marked in periportal tissues. Gall bladder: no gross lesions. Microscopic—acute inflammation throughout wall: mucosa fairly well preserved (Fig. 1). Common duct: Microscopic—acute inflammation with infiltration of walls with leucocytes: mucosa well preserved.

Dog 2. Four cubic centimeters staphylococcus aureus and (second injection) 6 cubic centimeters staphylococcus aureus. Killed 3 days after second injection.

Autopsy. Liver: œdematous, dark in color. Microscopic—hepatitis marked: infiltration of polymorphonuclears, marked cell vacuolization. Gall bladder: pale in color—adhesions to liver. Microscopic—marked acute inflammation: mucosa preserved. (Staphylococcus aureus demonstrated in walls.) (Fig. 2.)

Dog 6. Six cubic centimeters staphylococcus aureus. Killed 3 days after injection.

Autopsy. Liver: No marked gross changes. Microscopic—acute hepatitis, general infiltration of polymorphonuclears especially marked in interlobular sheaths and general hæmorrhage into parenchyma (Fig. 3). Gall bladder: gross, red, hæmorrhagic, many adhesions. Microscopic—marked acute inflammation throughout wall: mucosa well preserved.

Dog 7. Five cubic centimeters staphylococcus aureus. Killed 4 days after injection.

Autopsy. Liver: somewhat œdematous, friable; dark color; abscesses (Fig. 4). Microscopic—generalized acute hepatitis; many polymorphonuclears. Gall bladder: wall greyish pink with numerous adhesions (Figs. 5 and 6). Microscopic—acute inflammation; slight involvement of mucosa. Common duct: acute inflammation throughout wall; marked congestion of submucosa and ulceration of mucosa.

Dog 3. Five cubic centimeters staphylococcus aureus and (second injection) 2 cubic centimeters streptococcus. Killed 5 days after second injection.

Autopsy. Liver: several abscesses, scattered. Microscopic—general hepatitis; many leucocytes especially in the periportal sheaths and immediately under the capsule of the liver (Fig. 7). Gall bladder: adhesions to liver, quite firm; wall grey. Microscopic—acute inflammation involving entire wall with preservation of mucosa. Common duct: mucosa ulcerated, submucosa and muscular coat congested and infiltrated with leucocytes (Fig. 8).

Dog 1. Five cubic centimeters staphylococcus aureus. Killed 6 days after injection.

Autopsy. Liver: Somewhat swollen, greyish blue color, edge rounded (Fig. 9). Microscopic—extensive hepatitis; marked infiltration of polymorphonu-

clears, most marked in interlobular sheaths. Gall bladder: bound to liver with adhesions. Microscopic—marked inflammation with polymorphs throughout wall (Fig. 10); mucosa markedly involved. Common duct: acute inflammation, marked. The entire wall was congested and infiltrated with polymorphonuclears and some red blood cells.

The pancreas was examined in all seven dogs. The findings are reported in Part IV.

Three dogs required a second injection of organisms to produce a definite cholecystitis. The livers in this series showed a strikingly uniform picture, i.e., a general hepatitis, leucocytic infiltration, general but more marked around the central veins. The gall bladders showed various degrees of inflammation with involvement of the entire wall except the mucosa. The mucosa was markedly involved in only the later stages of the process.

Series G. The liver and gall bladder studied in experimental general peritonitis. In an effort to interpret the pathology of the liver reactions, a generalized peritonitis was produced in four dogs by traumatization of intestines and injection of fæces, intraperitoneally. These animals were killed after various intervals, from 24 to 96 hours. Sections of the gall bladder and liver were studied. A cholecystitis was found in two dogs. The mucosa of the gall bladder was not markedly involved. The liver showed various reactions. As a rule there was a general involvement of the entire organ. In the gross it was dark, œdematous, and friable, and, in a few cases, abscesses were found. In section the pictures were variable. There was usually a general hepatitis and pericholangeitis, in some parts a central necrosis, and in others hæmorrhage into the parenchyma of the organ. The whole reaction was similar to that observed following portal vein injection. This picture differs essentially from that produced when the liver is involved secondarily from the gall bladder.

Series H. Demonstration of organisms in the wall of the gall bladder after portal vein injection. In this series six rabbits were used. The cystic duct and vessels were ligated. Two cubic centimeters of hæmolytic streptococcus was then injected into the portal vein. The rabbits were killed after 1, 2, 12, 24, 24, and 48 hours respectively. Sections were stained for bacteria in addition to the hæmatoxylin-eosin stain. Blocks were cut of the gall bladder with the adjacent liver in the normal relationship.

In all of these sections streptococci were demonstrated in the liver. In the one and two hour sections, the organisms were found in the region of the veins and between the cells of the parenchyma. In the latter sections organisms could be demonstrated within the cells and surrounded by phagocytes. In sections from four rabbits streptococci were demonstrated within the gall-bladder wall.

Part III

Appendicitis and Peptic Ulcer as Associated with Cholecystitis

The history of appendicitis and gastric and duodenal ulcer in their relation to cholecystitis is almost entirely a clinical one. Many earlier clinicians and a few experimental investigators made occasional comment on the relationship, but few studied the problem or reported experimentation.

Adrian (77), in 1901, was among the first to conclude that appendicitis was a blood infection. Very little experimental work was done at this time. A number of clinical reports, however, show interesting statistics. In the Mt. Sinai Hospital Report of 1904 (78) there were 7 cases of ulcer coming to operation in which 3 showed foci of infection within the area drained by the portal vein. Ochsner, who was among the first to observe the relation between appendicitis and gall-bladder disease, reported in 1906 (79) 4 cases of pyloric ulcer, 2 of which were associated with biliary tract infection, 2 with appendicitis (1 case had both lesions), and 13 cases of biliary-tract infection of which 4 had pyloric ulcer and 7 appendicitis. In the following year, Deaver (80) reviewed 66 cases of ulcer, 15 of which gave a history of preceding dysentery, typhoid, appendicitis, or biliary-tract infection. Kretz (81) observed a number of cases of appendicitis following angina and stated that this was proof of the hæmatogenous origin. In the later paper (82) he concludes that, considering the results of these new experiments (about 60 cases) he must regard the hæmatogenous origin of appendicitis as typical. Aschoff (83), in the same year, was

convinced that angina and appendicitis were similar infections of bacterial origin and that tonsillitis may cause appendicitis. Cannon (84) reached the same conclusions.

In 1908 Moynihan (85) reported 205 cases of ulcer, 16 of these required biliary-tract surgery. The appendix was not examined. Gibbon and Stewart (86) reported 22 cases of ulcer with perforation, which came to operation. In 6 appendicitis was diagnosed before operation and chronic inflammation of that organ found on removal; in the remaining cases the appendix was not examined. MacCarthy and McGrath (87) reported a very thorough pathological study at operation and at autopsy. In 52 ulcers, 26.9 per cent were associated with chronic appendicitis. One hundred and seventy-five cases of biliary-tract infection showed almost 50 per cent associated with chronic infection of the appendix. Of 2000 chronic appendices, 8.7 per cent had biliary-tract infection.

From this time on the coincidence of these lesions was given increasing attention. The Augustana Hospital Report for 1910–11 (88) contained the following statistics: 514 chronic appendices of which 45 had biliary-tract infection; 79 ulcers of which 35 had chronic appendices, 14 had biliary infections, and 7 had all three lesions. Of 141 cases of biliary infections, 5 had ulcer, 68 had chronic appendices. Pilcher (89) reported a very excellent study of the relation between appendicitis and biliary and gastric lesions. He studied 100 cases of chronic gastritis (proved by sections) and found that 36 had appendicitis; 12 had appendicitis and biliary-tract infection; 60 had biliary-tract infection; 16 had biliary and pancreatic infection. Mitchell (90) reported 48 pyloric ulcers, 19 of which were associated with chronic appendicitis.

In 1912 Aschoff (91) advanced the view that appendicitis was due to a specific streptococcus and began as an embolic infection. Rosenow (60) held the same view and produced appendicitis in animals by injecting "specific" streptococci obtained from cases of human appendicitis. He claimed to have obtained positive lesions in 68 per cent of his injections. Ghon and Namba (92) also believed appendicitis an hæmatogenous infection caused by a specific organism. Heyde (93), in a most complete review of appendicitis and an exhaustive investigation, concluded that several organisms were responsible for the lesion. Heyde's experimental investigations were thoroughly detailed, yet no mention is made of associated lesions. Moynihan (94) in his monograph on "Duodenal Ulcer," reported some interesting data. In 62 cases of ulcer, 6 required biliary drainage, 25 had chronic appendices; 2 had appendicitis and biliary drainage and ulcer. A study of the appendix in 14 consecutive cases of pyloric ulcer showed 12 chronic appendices, the remaining 2 cases were too ill to permit further study.

Moynihan believes that the appendix should be removed in 90 per cent of cases of ulcer and biliary disease. In 1910–11, of 322 ulcers operated upon, Moynihan discovered 111 chronic appendices requiring appendectomy.

La Roque (95) gave the following causes for pyloric ulcer: central necrosis of an area of inflammation; necrosis caused by bacterial infection; source of bacteria, some focus of inflammation in the area drained by the portal vein. He added: "Pyloritis, pyloric ulcer, bile-tract infection, pancreatitis, and perhaps, cirrhosis of the liver, are late results of infection primarily located, most commonly, in the appendix though in many cases in some other region drained by the portal vein; and these lesions frequently exist together in the same patient at the same time or may follow each other in rapid or slow succession."

Rosenow (96), in 1914, submitted further experimental investigation. He produced appendicitis in animals by the intravenous injection of streptococci made virulent by animal passage. In 1915 (97) he produced appendicitis in 41 of the 59 rabbits injected. He used for these injections, the organisms recovered from cases of human appendicitis (recovered at operation). Deaver (98) summed up what is probably the modern practice in surgery when he stated that in case of gall-bladder infection, whether there are calculi or not, operation should include removal

of the appendix and examination of other abdominal viscera for associated disease.

The appended experimentation on appendicitis is very meager. No work was done on ulcer. Only three animals were used for experimentation.

In two rabbits the appendicular vein was injected with 3 cubic centimeters of hæmolytic streptococci. The animals were killed (A. V. $I._1$) and (A. V. $I._2$) 2 hours after injection. In a third rabbit 4 cubic centimeters of hæmolytic streptococcus (24-hour broth culture in all 3 cases) was injected into the appendix wall. This animal was killed 4 hours after injection (A. I.).

In all three cases sections were made of the liver, gall bladder and the liver (with their normal attachment), pancreas, and common duct. In all three of these animals the injected organisms were demonstrated in the liver by culture and in section. In A. V. $I._1$, A. V. $I._2$, and in A. I., the organisms were demonstrated within the gall-bladder wall, liver, and pancreas in sections (Figs. 11, 12, 13, and 14). (For common duct and pancreas see Part IV.)

Part IV

Cholecystitis and Pancreatitis

The history of the relation between infections of the pancreas and the biliary system is a most interesting one. In 1896, Nicholas Senn (99), one of the pioneers in the surgery of the pancreas, made the following observations: "Peripancreatic suppuration commences, in most instances, in the adjacent lymphatics. . . . The presence of pus within the pancreas or in its immediate vicinity is not indicated by any characteristic or positive symptoms. The symptoms always point to the stomach or liver as the seat of the disease. . . . In several instances the inflammatory process in the pancreas extended to the bile duct, or caused stenosis of the duct by compression, conditions which are usually followed by biliary retention, a symptom which has been usually interpreted as evidence of primary disease of the liver or bile ducts."

The important work of Opie (100) is perhaps the greatest contribution to our modern conceptions of the pancreas and its diseases. Most of Opie's observations were confined to cholelithiasis and were considered from the standpoint of obstruction. Regarding "the association of acute pancreatitis and cholelithiasis," he advances the following considerations: "The etiology of hæmorrhagic necrosis of the pancreas has remained obscure until a series of cases recently studied has demonstrated a relationship between the lesion and cholelithiasis. Since the common bile duct and the duct of Wirsung unite to form the diverticulum of Vater before they reach the duodenum, changes in the one duct may be transmitted to the other, thus producing secondary lesions of the liver or pancreas. The association of pancreatic disease with alterations of the bile passages has been noted by Koerte, Oser, Lancereaux, and other writers. . . . The cases which have been cited suggest no process nor mechanism by which a lesion of the pancreas results from the presence of a calculus in the common bile duct near its duodenal orifice. The autopsy upon a second case of hæmorrhagic necrosis of the pancreas studied in the partial light of that already described (Case I) has demonstrated a mechanism by which a small biliary calculus produces a destructive lesion of the pancreas and at the same time has brought our knowledge of the lesion into correlation with facts demonstrated by experimental means. The preceding autopsy has disclosed a condition which explains, I believe, the pathogenesis of cases of so-called acute hæmorrhagic and gangrenous pancreatitis which are associated with gall stones. The diverticulum of Vater was 10 millimeters in length. Lodged at its apex, blocking the duodenal orifice, was a small calculus only 3 millimeters in diameter, but too large to pass the narrow opening. Though it occluded the duodenal orifice of the diverticulum, it was so small that the orifices of the common bile duct and of the pancreatic duct were obstructed. The two ducts were, therefore, converted into a continuous closed channel from which it was not possible for either bile or pancreatic juice to escape. . . . The etiology of interstitial inflammation is often obscure. Chronic pancreatitis is not infrequently secondary to changes

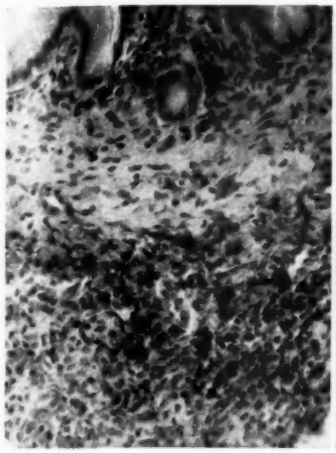


Fig. 1.

Fig. 1. (Dog 4.) Gall-bladder wall showing acute inflammation.

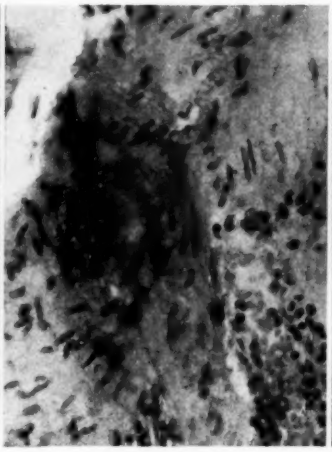


Fig. 2.

Fig. 2. (Dog 2.) Gall-bladder wall near liver.

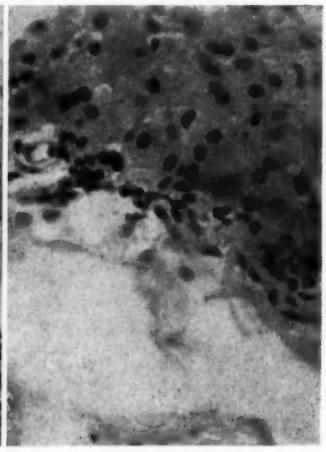


Fig. 3.

Fig. 3. (Dog 6.) Liver.

in the intestine, bile passages, and the liver. As with other glands, there is more than one path by which inflammatory irritants may reach the organ; by way of the duct, from the blood vessels, and possibly from the lymphatic vessels. . . ."

Nordmenn (101) stated that, in the production of acute hæmorrhagic pancreatitis by experimental means, two factors are necessary: first, complete stasis of pancreatic juice in the ducts, and secondly, multiplication of pancreatic juice in the stagnant secretion. Injection of the organisms without occlusion of the ducts produced no results. Heiberg (102), in his book, adds very little to Opie's observations. Regarding pancreatic inflammation he says that the establishment of an inflammation in the pancreas itself becomes possible when a gall stone is lodged for a longer or shorter time, especially when an infectious disease of the biliary tract, which is of itself a predisposing factor, precedes. Reidel laid emphasis upon his observation that enlargement of the pancreas could take place with a subsequent reduction in size. All 3 of his patients had gall stones. Reidel brought up the question of the danger which would have followed attempted removal of the stones in the belief that one was dealing with an inoperable tumor. However, why should one lay the cause of the jaundice to the pancreas when there are gall stones present at the same time? In the year 1903 Reidel considered the fact established that the hard tumors (enlargements) found in chronic pancreatitis, could readily return to their original size when the gall stones were removed.

It seems quite strange that the lymphatic connections between the biliary tract and the pancreas, with all of the possibilities for transmission of infection, should not have received greater attention. Deaver (103) who repeated Senn's observations about 27 years later stated: "The lymphatics, however, in my opinion, play a conspicuous rôle in conveying infection of the pancreas." Five years previous to this statement Maugeret (104), in his thesis, presented a most excellent contribution to our knowledge of the lymphatics of the pancreas, and pointed out the possibilities of infection by this route. His review of the history is good, his experimentation careful, and his conclusions are worthy of special consideration. Maugeret's conclusions are presented as translated:

1. Pancreatitis co-existing with cholelithiasis is not an affection independent of the latter, nor is it a contemporary or parallel affection, due to the same initial cause, and

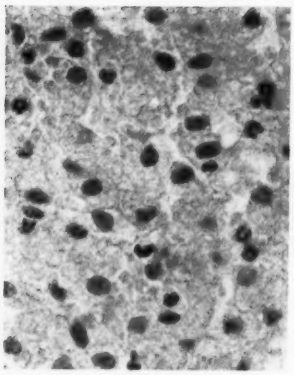


Fig. 4.

Fig. 4. (Dog 7.) Polymorphonuclears scattered throughout the liver lobule.

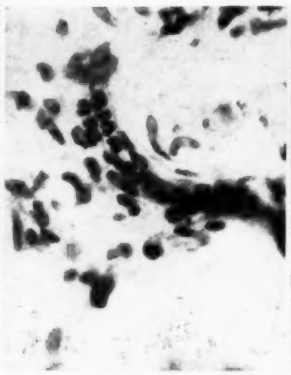


Fig. 5.

Fig. 5. (Dog 7.) Polymorphonuclear leucocytes in the deeper layers of the gall-bladder wall.

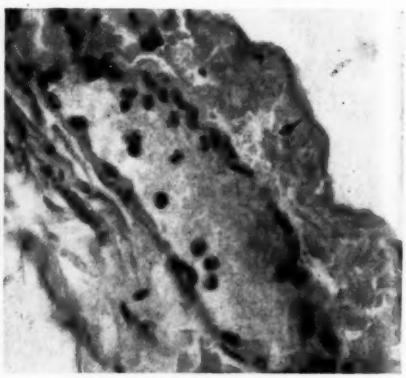


Fig. 6.

Fig. 6. (Dog 7.) Acute inflammation of the gall-bladder wall with numerous adhesions and slight involvement of the mucosa.

then simply maintained by it. It is a real complication, as shown by clinical observation and therapeutics.

2. Its point of departure is, neither directly nor indirectly, an intestinal infection, which has never been clearly demonstrated.

3. The infection does not reach the pancreas by the canalicular route; this propagation which neither the topography of the lesions nor their histologic localization can prove, has but very little chance of being produced, with the strong bactericidal properties of the pancreatic juice and the normal physiologic body of an excretory system (which keeps from stagnation by the absence of a diverticular reservoir).

4. Neither is it by simple contiguity that the infection reaches the pancreas; this method of spreading is liable to occur solely in conditions which are found after very rare cases.

5. In all cases of lithiasis that may occur, the pancreatitis seems to come from one cause, always the same in all these cases.

6. This sole cause of pancreatitis in all cases of lithiasis is the only constant condition which is common to all these cases, that is, the infection of the biliary vesicula; this is proved even by the treatment of this pancreatitis which consists essentially in the disinfection or suppression of the vesicula.

7. The vesicular infection spreads to the pancreas through the efferent lymphatics of the vesicule, ending in the important ganglionic group which, both periglandular and juxtaglandular, occupies the region around the head of the pancreas. This group also receives the efferent routes from the pancreas itself, and largely anastomoses between them and its surface; this surface is therefore situated in a veritable lymphatic crossroad which could easily be invaded through its periphery, since the infection tends to cross the ganglionic barrier.

8. It seems, therefore, that of the four possible modes of pancreatic infection—the blood route, canalicular route, contiguity, and the lymphatic route—the last mentioned is not only possible but frequent.

Regarding the anatomy of the biliary and pancreatic lymphatics Poirier (105) gives the following: "The lymphatics of the extrahepatic passages arise from two networks, one mucous, and the other muscular. The collecting trunks which arise from these networks end in the glandular satellite chain which is a satellite of the cystic and common bile duct. Intimate relations exist between the lymphatics of the terminal segment of the common bile duct and the lymphatics of the duodenum and the head of the pancreas."

Bartels (106) refers to Sappey as stating that the lymphatics of the gall bladder drain into the superior pancreatic lymphatics. It is of historical note that Bartels gives Olaus

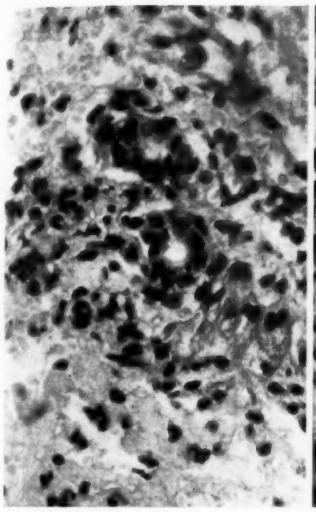


Fig. 7.

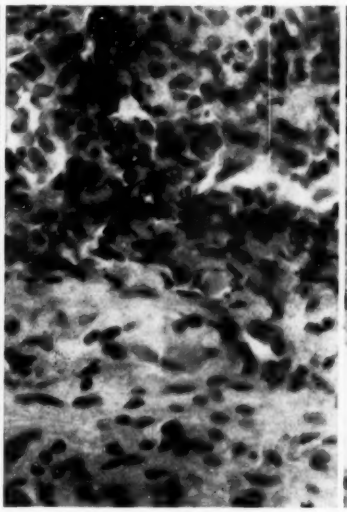


Fig. 8.

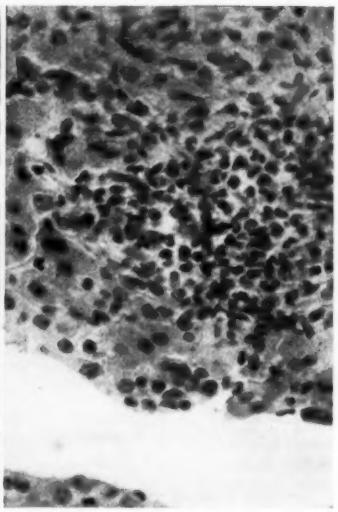


Fig. 9.

Fig. 7. (Dog 3.) Acute hepatitis.
Fig. 8. (Dog 3.) Wall of common duct showing acute inflammation.
Fig. 9. (Dog 1.) Liver: marked periportal infiltration with polymorphonuclear leucocytes.

Rudbeck (1659) credit for the first description of the lymphatic system as a separate vascular system. J. Vesling (107) gave a description, probably the first, of the lymphatics of the pancreas, in 1647. Free translation of his work conveys the following: "The chyle is taken up and delivered to the liver, not through any veins, but descending from the portal, now confirmatory, now distributory, to the veins. Asellius called these lacteals, so that the investigator should remember more readily, because the color of the liquid admitted was white. Moreover, the vessels are long and twisted, starting from a thin membrane upward from the pancreas, around the trunk of the descending vena porta from the liver downward, and from the intestines composed of very minute propagative vessels. The liquid is taken up from the intestine and the vessels are furnished with closing valves. These connections have to do with the spleen as well as the pancreas. The origin of the veins of these lacteals is not derived from any other source than from the pancreas. For nature extended the arteries and the red veins, by which they are recognized both in their composition and in their function, not from a narrow, forked-shaped base but from the more ample foundation of the trunks. In the same way the foundation of the lacteals is similar to the amplitude about the pancreas. The branches extend, indeed, to the liver and to the intestines. To collect all these into a common trunk on account of the marked width of the pancreas was not pleasing to the divine conductor; who held it sufficient that in whatever manner connection should be made between the nerves and the organs of the senses, they must come forth from some common spring but at distinct intervals."

Bartels in a later work (108) on the lymphatics of the pancreas said that, "of especial interest was a lymph vessel in the hepatoduodenal ligament which also showed the blue color (injection fluid); this is connected with a part of the pancreas. From this lymphatic there is a blue stripe leading up the portal vein toward the liver, which cannot be followed farther." Arnstein (109) in 1912 reviewed the works of Bartels, Maugeret, and Arnesperger and emphasized the importance of the lymphatic origin of pancreatitis secondary to biliary infection. Klippel (110), as early as 1897, made the observation that tuber-

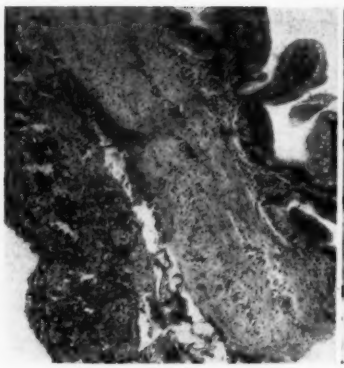


Fig. 10.

Fig. 10. (Dog 1.) Extensive inflammation of gall-bladder wall; mucosa relatively unaffected.

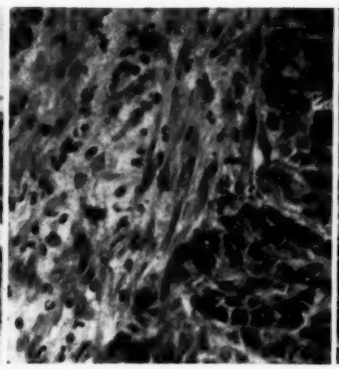


Fig. 15.

Fig. 15. (Dog.) Acute interstitial pancreatitis.

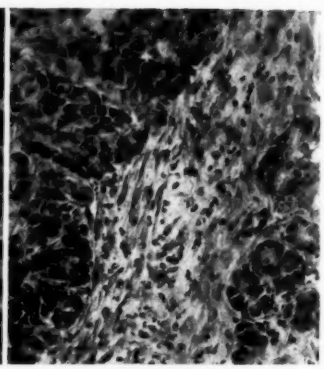


Fig. 16.

Fig. 16. (Dog.) Same as Figure 15, another animal.

culous pancreatitis was a secondary infection propagated by "*le système lymphatique.*"

A study of the pancreas of the seven dogs reported in Part II, Series F, revealed changes of note. Four of the seven organs showed a definite involvement. In two there was a marked acute inflammation with infiltration of leucocytes and beginning destruction of gland parenchyma. The lesions were definitely interstitial pancreatitis. One showed a moderate peripancreatitis and one a mild degree of pancreatitis (Fig. 16). In the experiments quoted in Part III, i.e., appendix injection, sections were made of the pancreas. In section A. V. I_1, streptococci were demonstrated in the common duct immediately surrounding a lymphatic vessel passing in intimate contact with the pancreas. In experiment A. I. a section of the pancreas showed staphylococci in the peripancreatic tissue (Fig. 17). There seems to be little doubt that organisms once introduced into the appendicular or biliary lymphatics easily gain access to the pancreas. Obstruction or stasis is not absolutely essential to production of acute pancreatitis.

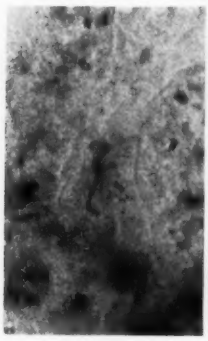


Fig. 11.

Fig. 11. (Rabbit.) Experimental hepatitis: organisms in liver near attachment to gall bladder. Portal vein injection streptococci.

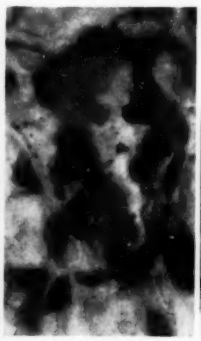


Fig. 12.

Fig. 12. (Rabbit.) Same as Figure 11, another animal. Twelve hours after injection.

Fig. 13.

Fig. 13. (Rabbit.) Experimental cholecystitis; organisms in gall-bladder wall 2 hours after portal vein injection with ligation of cystic duct and vessels.

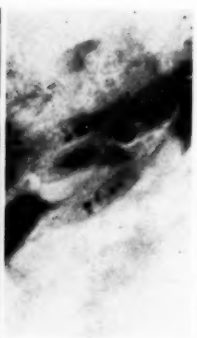


Fig. 14.

Fig. 14. (Rabbit.) Same as Figure 13, another animal, 12 hours after injection.

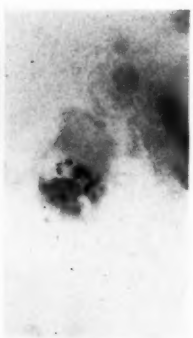


Fig. 17.

Fig. 17. (Rabbit.) Organisms in pancreas 12 hours after injection of portal vein.

PART V

A STUDY OF 130 CASES OF HUMAN GALL-BLADDER DISEASE

Throughout the prosecution of this investigation the co-existence of the several associated lesions with cholecystitis has stimulated a further and more exhaustive consideration of analogous conditions in the human. This study was made on the last 130 (unselected) cases of gall-bladder disease admitted to the Surgical Service of Barnes Hospital. The object in reviewing these histories and the sections was to study in detail the pathological findings in gall-bladder disease and its complications. The earlier histories were considered mostly for the sake of comparison, the findings recorded probably having been quoted on account of their outstanding features since no especial thought was given to the complications. These early reports then are of distinct value. Thirty-three cases were critically analyzed and studied in greater detail, which included a study of the gall-bladder wall, and of sections of the liver removed at operation. In seven other cases which came to autopsy the liver was studied microscopically.

In addition to the pathological studies, these cases show other interesting features. Of the 130 cases, 80 were females, and only 17 of these women gave no history of pregnancy. Cholelithiasis (with or without complications) as a pre-operative diagnosis was made 92 times and stones were found in 79 cases; cholecystitis (exclusive of stones) was diagnosed in 30 instances; the remaining 8 cases were diagnosed variously as carcinoma of the pancreas, etc.; carcinoma of the common duct; appendicitis; and duodenal ulcer. Twenty gall bladders were reported "not markedly abnormal" on gross appearance. All, however, showed pathological changes on section. The liver was found involved in 82 cases, no mention of the liver made (or "incomplete examination," or "marked obesity," or "marked pain prohibiting physical examination") in 38 cases, while in the remaining 10 cases the organ was reported "normal," "not enlarged," or "no marked changes." Small sections of the liver were taken at operation from 26 cases. These sections were studied in great detail. One hundred and thirty gall bladders were carefully studied and will be considered below.

In 82 cases of liver involvement, 69 were "enlarged," or "œdematous," 5 showed "adhesions" alone, and 8 were atrophic or scarred. Of these cases 7 came to autopsy where further study was possible. In this connection, it is of interest to note that of the 7 cases autopsied, no mention was made of the liver on physical examination or at operation in 3. In these 3 cases the pathologists reported as follows: in one "polymorphonuclear infiltration extending into the liver from the gall bladder; also vacuolization of the liver cells"; in another, "marked infiltration of round cells and polymorphonuclears about the portal vein and bile ducts"; and in a third, "infiltration about the portal vessels and bile ducts with polymorphonuclears and mononuclears, beginning fatty degeneration." Examination of these sections confirmed the reports. Changes were also found and studied in the remaining 4 autopsied livers.

The chief interest in a study of these cases was the frequency and the nature of hepatic involvement. Definite hepatic pathology was noted in 63.77 per cent of the cases. This percentage is far too low, especially in view of the fact that a number of livers reported normal were later proved to be involved and about 30 per cent of the cases contained no mention of the liver findings. In a complete study of 33 cases the liver was found involved in every case. This involvement consisted, in gross, in findings which varied from slight œdema and rounded edge to enlargement well down into the abdomen. Microscopically these livers showed a constant, uniform picture. In the acute cases there was a pericholangeitis, at times a general hepatitis, with infiltration of polymorphonuclear leucocytes into the interlobular spaces especially around the bile ducts. These inflammatory changes have been found to be more marked in the gall-bladder region. In the chronic cases there was observed an increase in connective-tissue elements in the periportal or interlobular spaces with a mild or moderate

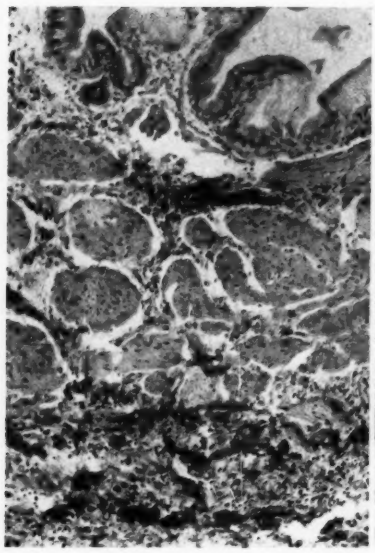


Fig. 18.

Fig. 18. Human gall bladder; wall extensively infiltrated with leucocytes, mucosa relatively intact.

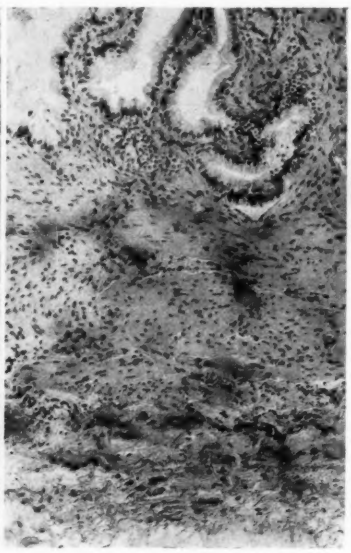


Fig. 19.

Fig. 19. Human gall bladder; mucosa relatively intact; infiltration of leucocytes in the outer layers of the wall.

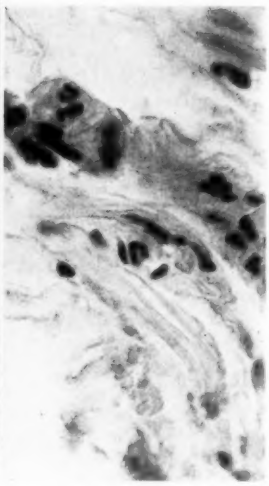


Fig. 20.

Fig. 20. Human gall bladder; leucocytic infiltration of wall; apparently thrombosed lymph vessel near serosa of wall.

infiltration of mononuclear leucocytes. The gall bladders in this series in great majority showed an inflammation of the entire wall with many times a fair preservation of the mucosa (Figs. 18 and 19). In previous reports (33 and 73) these findings have been noted and reported. Sections of the liver following portal vein injection (see Part II) show hepatic lesions which are considered as characteristic of primary infection of the liver followed by a cholecystitis. This pathological picture is more typical of a hæmatogenous one. (In this regard it is believed that the frequency of cholecystitis in women who have borne children may be explained by infection of the liver [since all of the abdominal viscera are more congested and exposed to infection], following which there is a localization of organisms in the gall-bladder wall. Here the organisms remain quiescent until suitable conditions afford opportunity for their development with the subsequent results.)

Regarding infections of the liver as to primary or secondary involvement, there will always be difficulty in explanation. It is easily conceivable that micro-organisms could set up an inflammation in the liver which would be transmitted to the gall bladder. In this organ the bacteria might become lodged and remain dormant while the hepatitis or primary infection subsided. The liver, as is well known, possesses remarkable bactericidal properties. Cholecystitis probably begins in most instances as an infection within the wall of the gall bladder, and doubtless, in many cases, it is secondary to a hepatitis. This infection may be acquired from the appendix, intestines, etc., or it may be secondary to any infectious focus within the body. The infection may then spread easily by the lymph stream to the wall of the gall bladder (Fig. 20). The complications then follow.

Mallory (111 and 112) describes the liver changes in typhoid fever as "one produced in the lymphoid tissue, which occurs in the so-called portal spaces, and which shows changes identical with those in the Peyer's patches;

the other occurring anywhere within the lobule, and involving the destruction of a group of liver cells." Given, therefore, an involvement of the lymphatics of the liver, a secondary involvement of the gall bladder through the lymphatics is easy of conception. The frequency of cholecystitis with and following typhoid fever is thus readily explained.

PART VI

DISCUSSION

From a review of the literature presented here and also from the experiments done in this laboratory, it is evident that cholecystitis and biliary-tract infections may be produced in a variety of ways. Any experimental method by which virulent organisms are carried through the blood stream directly to the gall bladder is followed in the majority of cases by the development of a cholecystitis. Experiments reported in this article and also some previously reported in conjunction with Priest and Graham (33 and 113) serve to emphasize the importance of the lymphatic route in the pathogenesis not only of cholecystitis, but also of its complications, such as pancreatitis, hepatitis, and inflammation of the common duct. Although the possibility of the lymphatic rôle in the pathogenesis of pancreatitis secondary to cholecystitis has been mentioned before, particularly by Maugeret, it is thought that the experiments carried out in this laboratory are the first which have brought direct evidence indicating that cholecystitis is not infrequently lymphogenous in origin. The evidence, both experimental and clinical, seems to suggest strongly that perhaps in the majority of cases cholecystitis is produced secondarily to a hepatitis by lymphatic extension. This conclusion is based on a number of facts: (1) The well-recognized association of lesions of the portal system (appendicitis, duodenal ulcer, etc.) with cholecystitis suggests that organisms are carried through the portal vein to the liver from these lesions and that a hepatitis occurs before the cholecystitis because there is no direct pathway between the appendix, for example, and the gall bladder. (2) By direct injection of organisms into a radicle of the portal vein, as, for example, the appendix vein, it is possible to produce cholecystitis. (3) There is no direct route by the blood stream by which organisms can be carried to the gall bladder from the liver, since the cystic artery and the other smaller arteries which are the only source of arterial blood to the gall bladder are branches of the hepatic. Organisms, therefore, to gain access to the gall bladder from the liver via the blood stream, would have to travel the circuit of the whole systemic circulation from the liver back through the cœliac axis and the hepatic artery. This would seem an unlikely occurrence in the majority of instances. Only two possibilities, therefore, remain. One is that the infection spreads from the liver to the gall bladder through the abundant lymphatic connections and the other is that organisms pass down in the bile into the gall bladder. There are several reasons, however, for thinking that, contrary to a common belief, descending infection of the gall bladder from the bile is comparatively rare. One of these reasons is that it is almost impossible to produce experimentally a cholecystitis by merely putting bacteria into the lumen of the gall bladder unless at the same time one injures the wall severely either by direct means or by interference with the circulation, or unless the cystic duct is obstructed so that the gall bladder cannot empty itself. Another reason is that, also contrary to the usual belief, in human cases the mucosa is usually less involved, as shown microscopically, than is the rest of the wall. This could hardly be expected to be the case if cholecystitis commonly occurred as the result of contact infection of the mucosa of the gall bladder from bacteria present in the bile. The unlikelihood, therefore, of the development of cholecystitis merely from the presence of organisms within the bile leaves the lymphatic route as the one which is perhaps most probable in many, if not in the majority, of cases. Such a lymphatic infection would begin in the deeper layers of the wall of the gall bladder rather than in the mucosa; and apparently this hypothesis coincides with the pathology found in cases of early gall-bladder infections in the human. The emphasis so commonly placed on the

appearance and changes in the mucosa of the gall bladder would seem, therefore, to be misdirected.

I wish to acknowledge with gratitude the kind assistance of Dr. E. A. Graham under whose supervision this work was done.

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TRAUMATIC SHOCK; SOME EXPERIMENTAL WORK ON CROSSED CIRCULATION[1]

By MONROE ANDERSON McIVER, M.D., Boston
Resident Surgeon, Service of Dr. Franklin G. Balch, Massachusetts General Hospital
AND
WILLIAM WAUGH HAGGART

IN the recent literature on the subject, a great deal of attention has been directed toward the theory that certain toxic substances taken up by the circulation from a traumatized area might be a factor in the production of the clinical picture known as "traumatic shock." This conception of the etiology of traumatic shock gained many adherents among both physiologists and clinicians during the intensive investigation stimulated by the World War, and a very extensive literature on this subject has grown up. The evidence at hand in favor of this theory, and a complete review of the literature, is furnished by Cannon[2] in a recent article.

Since Fredericq[3] in 1890 introduced the principle of crossed circulation, there have been several attempts to attack the problem of traumatic shock by means of some such method. The most elaborate technique proposed is one described by Bazett and Quinby.[4] According to their method, the entire systemic circulation may be crossed from one animal to another by means of an anastomosis made at the level of the ascending aorta. They hoped that this method might be adapted to the study of shock, but found that the animal in the better condition bled into the other so that no definite evidence could be obtained. Crile[5], during his studies on the effect of trauma on the brain cells, crossed the circulation of two dogs by means of an anastomosis between the carotid artery and the jugular vein; and Janeway and Ewing[6] carried out somewhat similar experiments in an attempt to supply the dog that was being traumatized with blood from a normally beating heart. These latter investigators found their experiments unsatisfactory because the recipient drained off so much blood that the donor soon became exsanguinated.

If substances capable of producing shock circulate in the blood of a traumatized animal, it should be possible by means of crossed circulation to produce shock in a non-traumatized animal. The difficulty in the experiment lies in the fact pointed out above that as soon as the traumatized animal develops the low blood pressure characteristic of shock, its vascular system acts as a reservoir which retains the blood from the normal animal. To avoid this difficulty, no attempt was made to cross the entire circulation; but the lower extremity was selected for traumatization, and by means of anastomoses between the aortæ and the venæ cavæ just above the bifurcations the circulation of that area was taken over by a normal animal. (See diagram, Fig. 1.)

METHOD

Cats were used as the laboratory animals, and as far as possible animals of equal size and weight were selected. All the experiments were carried out under urethane anæsthesia. Eight cubic centimeters of a 25 per cent solution per kilo of body weight, administered by the stomach tube, were found to give a very satisfactory grade of anæsthesia. The operative procedures were performed on heated tables, and the body heat of the animal was kept up during the experiment by means of an electrically heated pad.

OPERATIVE PROCEDURES

As soon as the animals were fully anæsthetized, cat A (diagram, Fig. 1), the animal that was to take over the circulation of the traumatized area, was prepared for the experiment in the following manner. A mid-

[2] Cannon, W. B. Arch. Surg., 1922, iv, Jan.
[3] Fredericq, L. Arch. de biol., 1890, x, 127.
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[6] Janeway, H. H., and Ewing, E. M. Ann. Surg., 1914, lix, 158.

[1] From the Laboratory of Surgical Research, Harvard Medical School.

line incision was made in the neck, and a tracheal cannula inserted. Through the same incision, the carotid artery was prepared for the insertion of a cannula. Next, a low, mid-line, abdominal incision was made and the intestines were carefully packed to one side with gauze sponges wet with warm normal salt solution. This procedure exposed the lower portion of the abdominal aorta and the inferior vena cava. These vessels were dissected out so that they were freely mobile for a distance of about 3 or 4 centimeters and they were ligated at the level of the pelvic brim. The abdominal incision was then temporarily closed by means of clamps.

A low mid-line abdominal incision was now made in cat B (diagram, Fig. 1) and the abdominal aorta and inferior vena cava treated in the same manner as described for cat A, except that the vessels were ligated about 4 centimeters above the pelvic brim. The abdominal muscles were then cut through between the clamps, a tight ligature was placed around the lumbar muscles, and the lower extremity was amputated just above the ligature. The upper extremity of cat B was discarded at this point. In the early experiments the lower extremity was not amputated; but this procedure was necessitated by the fact that the large veins in the spinal canal itself furnished a route for the blood from Cat A to find its way into the circulation of cat B. In the later experiments, following amputation, the spinal canal was packed with bone wax to prevent hæmorrhage, and the stump was wrapped with gauze sponges soaked in warm saline solution. Before the crossed circulation was established, the amputated legs were traumatized by means of repeated blows with a hammer over the fleshy, muscular portion of the thighs, according to the technique described by Cannon and Bayliss.[1] Care was taken not to fracture the femur, and an effort was made to preserve the skin intact and to avoid injury to the femoral artery and vein.

The anastomosis was carried out by means of paraffined-glass cannulæ.[2] These cannulæ

[1] Cannon, W. B., and Bayliss, W. M. Med. Res. Com., Sp. Rep. Ser. No. 26.

[2] The original model for these tubes was very kindly furnished by Dr. Beth Vincent.

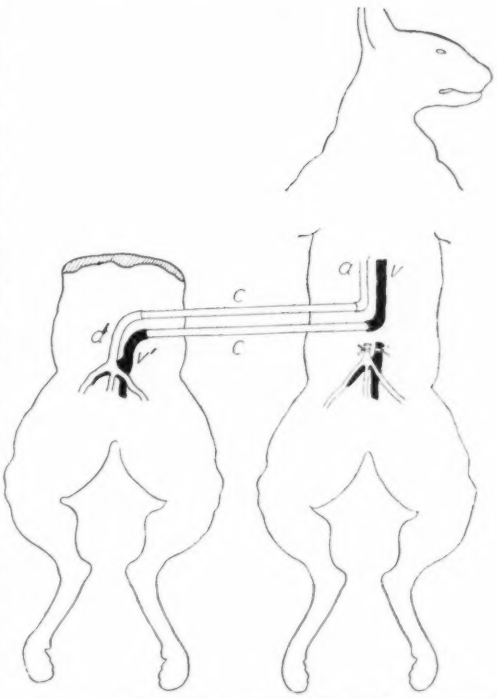

Fig. 1. Diagrammatic representation of the crossed circulation. The upper extremity of cat *B* is discarded immediately after the amputation has been carried out. *a*, Aorta, cat A; *v*, vena cava, cat A; *a'*, aorta, cat B; *v'*, vena cava, cat B; *c*, cannula.

were 10 centimeters in length; the aperture of the arterial cannula was a little over 1 millimeter in diameter, of the venous about 3 millimeters. The blood flow was controlled while the cannulæ were being inserted by means of rubber protected serrefine clamps. As soon as the cannulæ were in place, but before the clamps were removed from the vessels, a cannula connected with a mercury manometer was inserted into the carotid artery of cat A and a record of the blood pressure was started, which continued throughout the experiment. As soon as a preliminary blood pressure reading had been recorded, the serrefine clamps were removed, establishing crossed circulation.

DISCUSSION

The animal was considered to be in a state of shock when a persistent systolic blood pres-

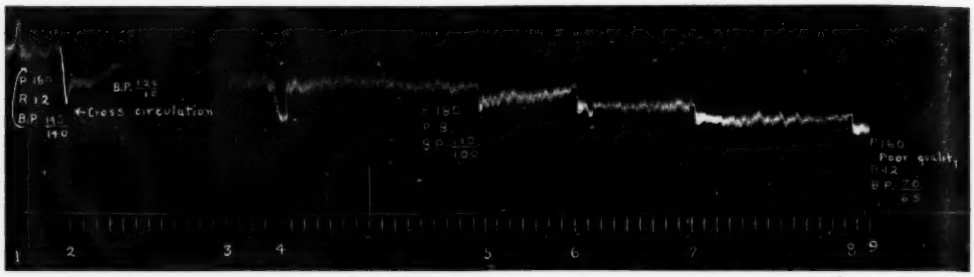

Fig. 2. Experiment No. 37. Weight of cat 3.1 kilograms. Urethane anæsthesia. The time intervals represent minutes. (1) Preliminary blood pressure reading 145–140. (2) crossed circulation established; (3 and 6) gentle massage of traumatized legs; (4) constriction of vein at point of anastomosis; (5, 7, 8) clot washed out of carotid cannula; (9) termination of experiment, blood pressure 70–65. The animal in a rather severe degree of shock.

sure of below 70 millimeters mercury was recorded. The character and rate of the pulse and respiration, the color of the mucous membranes, and the general condition of the animal, were also taken into consideration.

Figures 2, 3, and 4 show a typical blood pressure record taken during the progress of an experiment. The time intervals recorded at the bottom represent minutes. It will be observed that immediately upon establishing the crossed circulation a sharp fall in blood pressure is recorded. In most instances this is followed by a rise (Fig. 2). This is probably a purely mechanical factor and is dependent upon a sudden increase in the vascular bed to which the circulation soon adjusts itself. The progress of events from this point varies in different cases. In some instances a very gradual fall in blood pressure sets in at once and continues without interruption until the shock level is reached; usually in about 20 to 30 minutes (Fig. 3). In other cases the blood pressure maintains a fairly constant level, or may even show a slow rise, for a period of about 20 minutes, this in turn being followed by a gradual fall, which continues until the animal is in a state of shock (Fig. 2). It was noted that manipulation of the traumatized limb, or even gentle massage of the traumatized area, had a very depressant action on the blood pressure (Fig. 2),—a fact that had been pointed out by previous observers. Trauma of a more severe nature, such as that carried out in the preliminary traumatization, always produced a sudden marked drop in pressure (Fig. 4). In a few cases the animals developed no evidence of shock, and the blood pressure readings were well above the shock level at the end of an hour and a half, when the experiments were concluded.

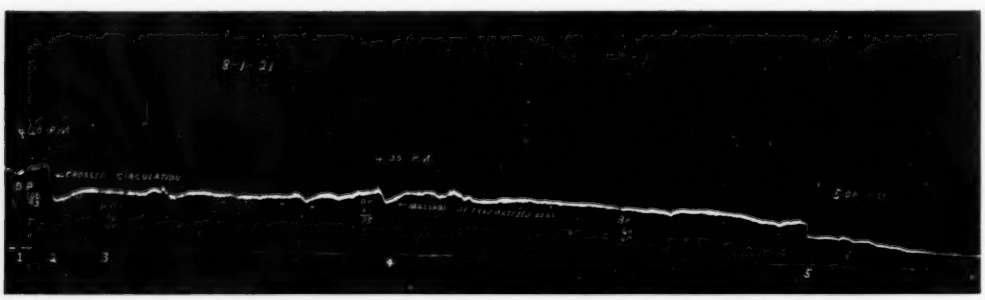

Fig. 3. Experiment No. 12. Weight of cat 2.1 kilograms. Urethane anæsthesia. (1) Preliminary blood pressure 100–95; (2) crossed circulation established; (3) blood pressure 74–68; (4) gentle massage of traumatized legs; (5) clot washed out of carotid cannula; (6) cat in a moribund condition, blood pressure 20–18. Experiment terminated 44 minutes after the crossed circulation had been established.

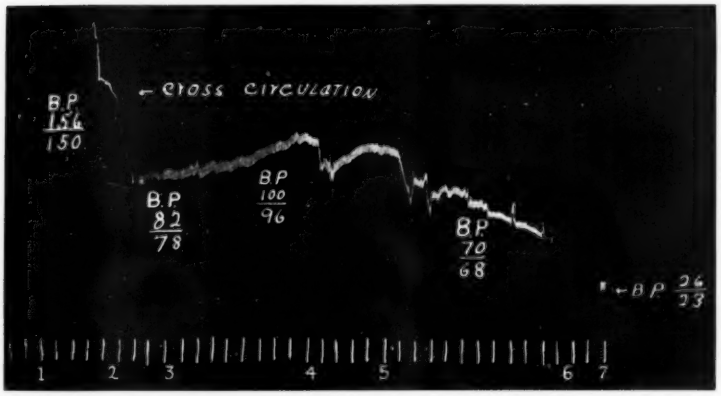

Fig. 4. Experiment No. 29. Weight of cat 2.2 kilograms. Urethane anæsthesia. The time intervals represent minutes. This tracing illustrates the very marked depressant effect on blood pressure produced by additional trauma of the injured muscles. (1) Preliminary blood pressure reading 156–150; (2) crossed circulation; (3) blood pressure reading 82–78; (4, 5, and 6) additional trauma; (7) experiment terminated. Cat in a moribund condition, blood pressure 26–23.

At the termination of the experiment the traumatized limbs were always autopsied. The blood vessels were dissected for any evidence of clot; and the traumatized muscles were examined in order to rule out any massive hæmatoma as the cause of the fall in pressure. It was our experience that the traumatization resulted in very little hæmorrhage into the tissue.

As controls, experiments were carried out in which the major traumatic procedure was omitted; that is, the lower extremity of cat B was amputated and the crossed circulation was established without any traumatization of the thigh muscles. Figure 5 shows a typical result of this type of experiment. The fall of blood pressure, followed by a rise, which occurs immediately after the establish-

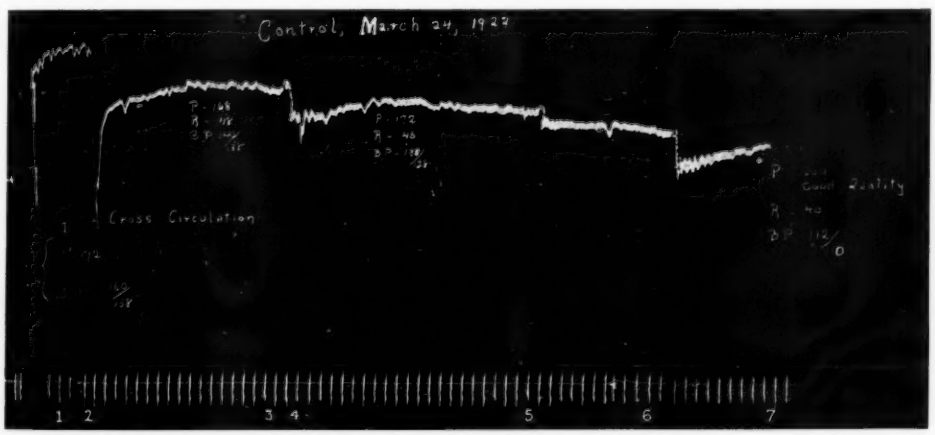

Fig. 5. Experiment No. 38 Control. Weight of cat 3.6 kilograms. Urethane anæsthesia. The anastomosis was effected without the major traumatic procedure. The time intervals represent minutes. (1) Preliminary blood pressure reading 160–158; (2) crossed circulation established; (3) blood pressure 140–138; (4) vein constricted to test patency; (5) clot washed out of carotid cannula; (6) stomach appeared somewhat dilated, relieved by passing a tube; (7) experiment terminated. The animal in good condition. Blood pressure 112–110.

ment of the crossed circulation has already been described. It will be noted that after this rapid adjustment of the circulation has taken place, the blood pressure remains well above the shock level and the animal's general condition is good at the termination of the experiment.

RESULTS

In summarizing the results, none of the earlier experiments in which the factor of collateral circulation might have been a source of error has been included; and all the experiments in which mishaps in technique might have influenced the results have also been ruled out.

Seventeen complete experiments were carried out. In 12 cases the major traumatic procedure was followed: that is, traumatization of the muscles of the thigh. In 9 of these experiments cat A, the animal which, under the conditions of crossed circulation, had taken over the circulation to the traumatized area, developed the typical picture of shock: the blood pressure fell to the shock level, in most instances, within 30 minutes of the time the crossed circulation was established.

In 3 cases no shock was produced—the blood pressure remaining at about its initial level when the experiment was stopped at the end of an hour and a half.

Five experiments were carried out as controls, in which the major traumatic procedure was omitted: the lower extremity of cat B was amputated and the crossed circulation established without any trauma of the thigh muscles. In four of these experiments cat A showed no evidence of shock at the termination of the experiment. In one case, at the end of an hour and a half the blood pressure had fallen to 70 millimeters mercury and the animal was considered to be in a state of shock.

In studying the etiology of traumatic shock, we realize that some of the most fundamental problems of physiology are involved and that very guarded conclusions should be drawn from any limited number of experiments. We feel, nevertheless, that evidence has been obtained suggesting that some substance capable of producing shock is taken up by the circulation from a traumatized area.

We wish to take this opportunity to thank Dr. W. C. Quinby and Dr. R. I. Lee for their helpful suggestions and criticism.

A PATHOLOGICAL STUDY OF A CASE OF CIRSOID ANEURISM

By FRANK L. MELENEY, M.D., Peking, China
Associate in Surgery, Peking Union Medical College

THE literature with regard to cirsoid aneurism is rather meager. The reports for the most part simply state the clinical aspects of the case, the method of treatment, and the result. Many of them are cases presented at medical society meetings and the records appear in local journals under society proceedings. An occasional author has reviewed the literature but only rarely have the pathological findings been described. The cases have been so infrequent that each author has been able to add but a single case to those which he has reviewed and the pathological description has therefore been specific rather than general or composite. In the literature of the last 30 years, out of 29 reports of cirsoid aneurism available, there are only two with a detailed pathological description. These are by Wagner (74) in 1894 and Keppler (32) in 1912. Inasmuch as these differ in some essential details from each other and from the case which I have had the privilege of observing, it seems worth while to report my findings. The differences may possibly be explained by a difference in the mode of origin of the tumor or the stage in which the tumor is found.

PATHOGENESIS

According to the opinions expressed in Wagner's review, cirsoid aneurism may arise in four different ways: (1) from a nævus or telangiectasis, (2) from a deep congenital anomaly of blood vessels (which may be of the same nature as a nævus), (3) from a single severe trauma, or (4) from a long-continued series of slight traumata. The first, third, and fourth modes of origin seem to be clearly borne out by case histories. The second is given as the probable cause in all other cases. This is, of course, theoretical and would be difficult to demonstrate. Wagner's article indicates that the congenital origin is represented in about 80 to 90 per cent of the cases and the traumatic in 10 to 20 per cent. More recent reports of individual cases seem to stress the traumatic factor, and Routier (63) has added the theory of a fifth causative agent, namely, an arteritis following an acute inflammation. He presents a case following the defervescence of a "phlegmon" and Reverdin (61) supports the theory with a case following a general "typhoid-like" infection.

The essential pathological condition is a pulsating tumor caused by an anastomosis between small arteries and veins without the interposition of capillaries. This was pointed out by Broca (79) in 1869, who is quoted by Wagner (74) as follows: "Some of the vessels showed a direct communication between artery and vein which indicates that these vessels must first have been capillaries and then by dilating changed either to arteries or veins." (It is not stated whether this gross finding was or was not confirmed microscopically.) This is believed by Wagner to be due to a perversion of development and, therefore, he considers the lesion to be a new-growth.

If Broca's theory of origin, as interpreted by Wagner, be true of cirsoid aneurisms of the congenital type, one is tempted to ask what factors determine whether these capillaries in their perverted growth shall develop into arteries or into veins or into some composite form. It is quite possible that the pathological picture of the tumor will vary according to whether one or the other element predominates in the perverted development. This may account for the fact that Wagner found only arteries in his specimen. He describes all of the vessels as having normal internal and external elastic lamellæ and adds: "I could not distinguish vessels which definitely characterized themselves as veins." Also Fabian, who gave the microscopical report in Keppler's (32) review, describes just one type of vessel which, from his description, seems to be an artery. In the case in hand, however, there are not only definite arteries and definite veins but intermediate forms, and Broca, grossly at least, definitely describes both arteries and veins. In the congenital

Fig. 1. Photograph of the patient before operation.

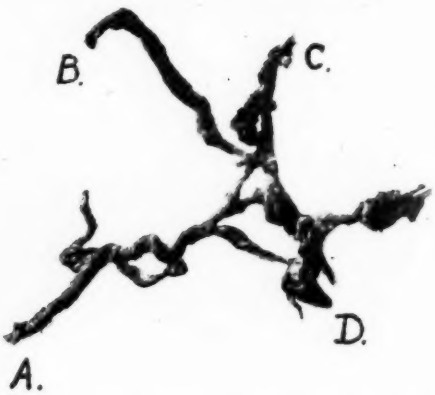

Fig. 2. A portion of the tumor teased apart, showing four relatively large vessels connected by a network of smaller vessels. ×2.

types it would seem reasonable to suppose that there are many communications between the arteries and the veins.

In the traumatic types it is possible that the communications may be made between vessels larger than capillaries and that physical factors may be more instrumental than those unknown factors causing perversion of capillary growth. It is likely also in the traumatic types that the communications would be fewer than in the congenital types. Thus the former approach more nearly to the true arteriovenous aneurism in which the communication is single between an artery and a vein of large caliber. The same would probably be true of a cirsoid aneurism of inflammatory origin.

If the capillaries simply dilate and do not develop the true muscular walls of arteries or veins, we have a simple non-pulsating cavernous hæmangioma. It is very evident in the literature that cirsoid aneurism has been frequently confused with cavernous hæmangioma and with arteriovenous aneurism. It is quite possible that there may be intermediate types of congenital cirsoid aneurism on the one hand and traumatic on the other which may present characteristics of these other forms of vascular disease.

This type of tumor has a great predilection for the head. V. Goehring (81), who collected 32 cases, found 23 on the head, 1 on the neck and 8 on the upper extremity. Schueck (80), who collected 87 cases, found 80 on the head, 1 on the neck and 6 on the extremities. Monnier (48) reported one case on the trunk. The predilection for the head is explained by some, with seeming plausibility, to be due to the increased vascularity of the part and the nearness to the heart and the consequent increase in blood pressure. Another important point that has been mentioned is the exposure of the head to trauma.

CASE REPORT

Hospital No. 1743, Ma Yu T'ang; nationality, Chinese; occupation, soldier; age, 34; admitted February 23, 1922. *Chief complaint.* Swelling under the chin, duration 9 years. *Present illness.* Swelling—onset gradual 9 years ago. When first noticed it was the size of a small bean. At that time the patient felt it pulsate. Gradual increase in size until 2 years ago when it began to grow more rapidly. It has always been soft and has not changed in character since the onset. Pulsation was noted at onset and has always been present. Within the past 2 years it has been annoying. Pain, none. Functional disturbances, none. General symptoms—none.

Patient gives no history of trauma, of venereal disease, of severe illnesses, or of other surgical conditions. He is a soldier, leads an easy, comfortable life, following the routine military activities. No known trauma to region involved. *The family history* is irrelevant.

February 23. Admission note (Fig. 1.): "Physical examination negative except for local condition.

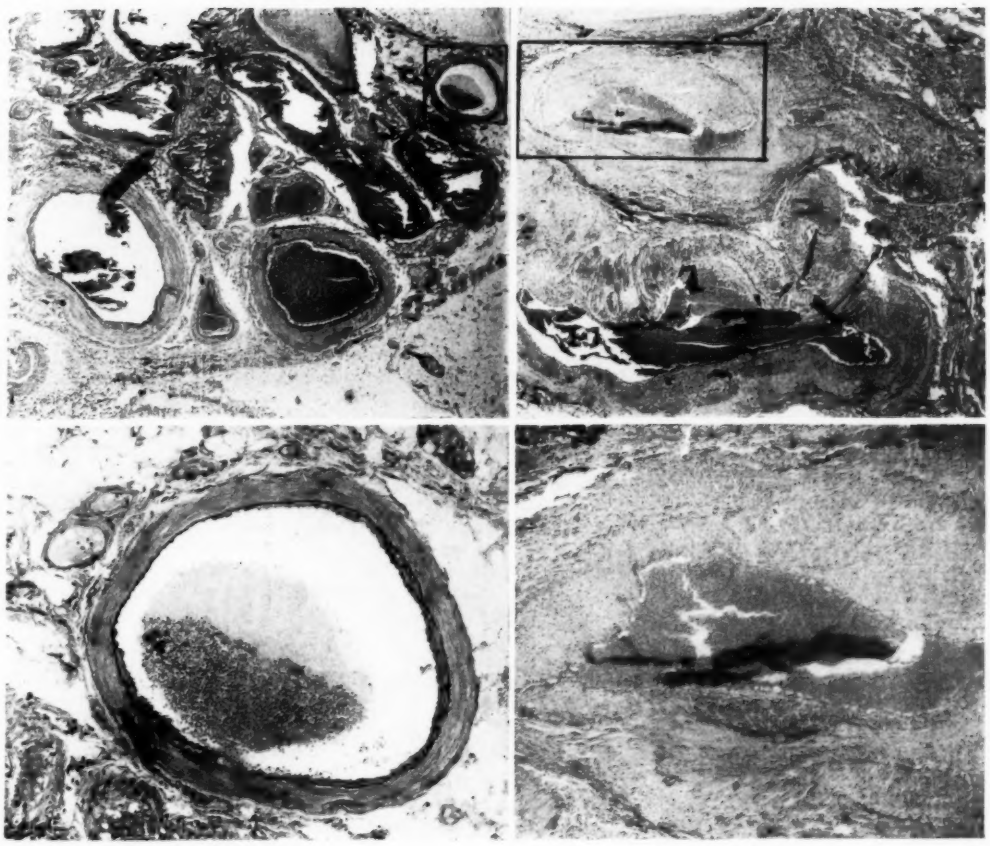

Fig. 3a (above, left). Photomicrograph of a portion of the cross section of the whole tumor, showing vessels of different types. Weigert-iron-hæmatoxylin-Van Gieson triple elastic stain. ×25.

Fig. 3b (above, right). Another portion of the same cross section showing vessels of still different type. ×25.

Fig. 4 (below, left). Photomicrograph of one of the arteries shown in Fig. 3a, included in the square, showing detail. ×100.

Fig. 5 (below, right). Photomicrograph of one of the veins shown in Figure 3b, included in the oblong, showing detail. ×75.

There is an irregular shaped swelling beneath the chin extending from just to the right of the midline to the region of the anterior border of the left submaxillary gland. It measures 5 by 3½ centimeters with the long axis transverse. With lateral observation a systolic pulsation is seen. The skin is not discolored over it but there seem to be serpiginous elevations beneath the skin, suggesting the presence of blood vessels. On palpation, the swelling is found to be soft. It feels like a tangle of blood vessels and is spongy. On continuous pressure the size of the swelling can be materially reduced, but it quickly returns to its original size by systolic increments of blood. No thrill is felt and no bruit heard on auscultation. The skin is loosely attached to the surface of the mass which in turn is fixed to the deeper structures. Pressure over the left facial artery at the jaw diminishes the pulsation slightly. Pressure over the left lingual artery does the same but pressure over both together does not completely control the pulsation. The facial artery does not seem to be materially increased in size. Floor of the mouth negative. Opinion. It is most likely a blood-vessel tumor of the cirsoid aneurism type."

February 24. Operative note: "A curved incision was made from the point of the chin down around the posterior margin of the tumor and outward for a short distance beyond the greater cornu of the hyoid bone. Beneath a thinned-out platysma a tangle of pulsating blood vessels was found posterior to the mandible, overlying the mylohyoid muscle and slightly overlap-

ping the anterior belly of the digastric in front and the submaxillary gland behind. It was decided to ligate the lingual artery which seemed to be the chief source of blood supply for the tumor. This was reached through Lesser's triangle. This ligature diminished the pulsation of the tumor by at least one half. The tumor was then dissected from below upward. Large vessels 2 to 3 millimeters in diameter were seen piercing the mylohyoid muscle and entering the base of the tumor. They were not pulsating and were evidently branches of the previously ligated lingual artery, either the suprahyoid or an aberrant branch. On dissecting upward, somewhat smaller pulsating vessels were seen entering the left side of the tumor, evidently the submental branch of the left facial artery. From the right side came the corresponding branch of the right facial and from above several smaller radicals from the inferior labial branch of the left facial. All of these vessels were ligated with fine silk. The skin was then closed by suture."

The wound healed primarily. Soon after leaving the hospital the patient was sent by troop movements up into Mongolia. Letter sent out for information regarding the condition of his health received no reply.

Pathological findings. Gross examination. "The specimen consists of a small, flat, oval mass of tissue measuring 3½ by 2½ by 1½ centimeters. On one side there is an oval piece of skin somewhat smaller than the mass itself. Beneath the skin there is a thin layer of muscle. On cross section, it is seen that the mass is made up of tortuous blood vessels, varying in size from 1 to 3 millimeters. The walls of these blood vessels are also variable in thickness. Some are relatively stiff and circular, while others are softer and flatter. Some contain blood while others are empty. Some are light and some dark in color. By teasing the vessels apart the relations are made more apparent. At one point a light colored vessel is seen to enter the side of a tortuous, dark colored vessel. At a point where these run parallel, a cross section is made to determine whether these are arteries or veins or both. (Fig. 6.) In another part a small thick-walled vessel is seen to enter a large thinner-walled vessel which is slightly sacculated at the point of junction. Another cross section is made of these vessels. (Fig. 7.) On the deep surface three vessels are seen entering the tumor. Two of these are thick-walled while the third is thin and collapsed. The vessels of the tumor are held together by connective tissue and fat, and in this substance a few small thick-walled vessels are seen. When the connective tissue and fat have been cut away from a part of the mass (Fig. 2), it is seen that there are three types of vessels. One type is relatively straight with thick but even walls. The caliber varies from 2 to 3 millimeters. The other type is varicose and tortuous with walls of varying thickness. These two types are connected by the third type, namely, vessels relatively small (not more than 1 millimeter in caliber) which form a network between the larger vessels. Sections are taken from four of the large vessels entering this network.

Microscopic examination. A cross section of the whole mass (Fig. 3) shows many large and small blood vessels varying in size from 0.1 to 3 millimeters. Almost all of them have rather thick walls. There are strikingly few capillaries. There are no large blood spaces. The vessels are held together loosely by relatively acellular connective tissue and fat. Some of the vessels are full of blood while others simply have a few red cells clinging to the walls. The blood mass in those full of blood has retracted somewhat from the wall and takes a scalloped appearance. No thrombosis is seen. The Weigert-iron hæmatoxylin-Van Gieson triple stain shows the elastic tissue exceedingly well. About one-third of the vessels have complete internal elastic membranes and about one-third have none at all (Figs. 4 and 5). These I think may be definitely called, respectively, arteries and veins. In the other third, however, the internal, elastic lamella is imperfect. In some of these vessels there is a heavy layer of elastic tissue on one side which frays out or becomes reduplicated or else disappears entirely, on the opposite side. In others, there are simply a few strands of elastic tissue in the general region of an internal, elastic membrane. The cross sections show considerable variation in the thickness of the wall of the individual blood vessels. This is less marked in the frank arteries than in the other vessels. In the arteries (Fig. 4) the variation consists chiefly in the thickness of the intima or in the region between the internal, elastic membrane and the media. The intima in all sizes of arteries varies from a single layer of endothelium to a layer one-third to one-half as thick as the media itself. This variation in thickness may develop suddenly so as to present an oval body projecting into the lumen. The Van Gieson stain shows that this redundant tissue is made up of both connective tissue and smooth muscle. With the elastic tissue stain a few fine, elastic, tissue fibers are also seen here. In a few arteries, similar tissue is found just outside the internal, elastic membrane pushing the latter toward the lumen. These masses are distinctly cellular. The media of the frank arteries is of fairly uniform thickness and is composed of smooth muscle with a small amount of connective tissue and elastic tissue. The external, elastic membrane is entirely missing in most of the vessels and is represented only by a few scattering elastic fibers in the others. The adventitia varies somewhat in thickness according to the size of the vessel, but in any individual vessel it is fairly uniform.

The other vessels (Fig. 5) in general show much more distortion of their walls than do the frank arteries (Fig. 4). In cross section the lumen of some of them is reduced to a narrow slit or distorted space. Although it is more difficult to distinguish the intima from the media in the vessels in which the internal elastic membrane is defective or absent, the distortion seems to be present chiefly in the intima but also to some extent in the media. In some vessels there are great, oval masses of tissue projecting into the lumen. This tissue is composed of both smooth muscle and connective tissue with a few elastic fibers and seems to

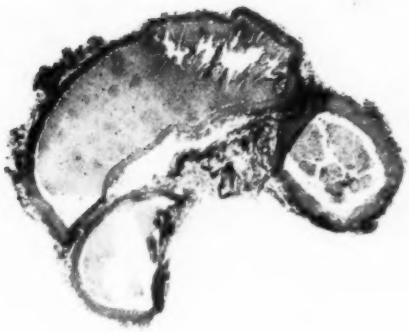

Fig. 6 (above, left). Photomicrograph of the first pair of large communicating vessels which are of the arterial type. (The broken vessel is a continuation of the large one turned upon itself.) ×25.

Fig. 7 (above, right). Photomicrograph of second pair of large communicating vessels of the venous type. ×25.

Fig. 8 (below, left). Photomicrograph of *A*, Fig. 2, one of the large vessels entering (or leaving) the network of smaller vessels. It is of the arterial type. ×50.

Fig. 9 (below, right). Photomicrograph of *D*, Fig. 2, one of large vessels leaving (or entering) network of smaller vessels. It shows three vessels of venous type. ×50.

indicate a hypertrophy rather than a simple scarring. In other vessels, there is a general infiltration of the media with connective tissue. At the same time the muscular tissue itself is thicker than in normal veins. In these vessels the external, elastic membrane is missing or fragmentary. The adventitia is perhaps in general thicker than in the vessels first described.

The endothelial lining of all types of vessels varies, but the differences do not correspond to the type of vessels. In some, the endothelial cells are flat and spread apart. In others they are rounder and closer together. This does not correspond to the state of dilatation, and the impression is given that a proliferation has taken place.

There is very little evidence of degeneration in the tissue. The nuclei stain well, and there are no deposits of fat or calcium in the vessel walls nor is there any hyaline degeneration. There is also very little evidence of infection other than the presence of moderate connective tissue infiltration. There is no cellular infiltration. Attention has been called to the cellular infiltration or degeneration of nerves but in the few small nerve fibers which are present there is nothing abnormal evident.

The sections from the two pairs of large communicating vessels show the first pair to be alike. Each vessel has a fairly complete, internal, elastic membrane and the walls are of uniform thickness. They resemble arteries (Fig. 6). The second pair are also alike but are of a different type from the first pair. The walls are thinner and more distorted, and there is no internal elastic membrane present. They resemble veins (Fig. 7). We have then no evidence of direct communication between large vessels of different type.

The sections made from the four large vessels communicating through a network of smaller vessels (see Fig. 2) shows *A* to be of the arterial type (Fig. 8) with an almost complete, internal, elastic membrane

and an even muscular wall. *B* is more of the intermediate type but with a small amount of real internal, elastic membrane which tends to classify it as an artery. *C* is a thin-walled vessel without elastic membrane presenting the characteristics of a vein, while *D* shows a group of thin-walled vessels all of the venous type (Fig. 9). We have, then, fairly large vessels of different types communicating with each other through a network of smaller vessels.

Grossly this case represents a relatively small cirsoid aneurism probably of the congenital type, in a rather unusual location which made it easily amenable to surgical treatment.

Microscopically the case differs from the one described by Fabian (32) in that in his case all of the vessels seemed to be of one type, thrombosis was frequent and, where the thrombus touched the wall, the intima was absent. No mention was made of any proliferation of the endothelium. Also there seemed to be evidence of degeneration in the intimal nodules and in the media as represented by peculiar "spot" in areas where the nuclei stained poorly. The intimal masses showed no details of structure. In his case there was a striking lack of elastic tissue in the vessel walls except in the well-developed, internal, elastic membrane.

This case differs from that described by Wagner (74) in that in his case all the vessels seemed to be arteries. The external as well as the internal, elastic membranes were well defined. Some of the smaller vessels were completely obliterated by the intimal nodules. Perivascular, round-celled infiltration was frequently seen.

The present case agrees with Wagner's in its demonstration of definite proliferation both in the endothelium of the vessels and in the intimal nodules, and also in the absence of evidences of degeneration. It seems justifiable to suppose that the reason why vessels of different types are found in this case and not in the others is that in this instance the proliferation took place in those elements which embryologically represented both veins and arteries. It may be that the partial development of an internal, elastic membrane in the intermediate types came either as a perversion of arterial development or arose in veins in response to the pulsations carried through the arteries directly into the veins. The fact that in the arteries the changes are relatively slight while in the veins or intermediate vessels the changes are striking, would seem to indicate that the excessive proliferation is due to a demand made by the physical forces of the abnormal circulation upon vessels not adapted, or poorly adapted, to withstand those forces. At the same time proliferative changes are taking place in the endothelium of the well-formed arteries as well as in the veins, as the pathological process continues and the tumor enlarges. Possibly the same factors which initiated the process are still going on. If this is a real new-growth, the nature of this process is at present as mysterious as it is for any other form of new-growth.

Further light will undoubtedly be brought to bear upon this interesting subject by the description and study of other cases. The clinical aspects are fairly clearly understood but the pathological processes still need further elucidation.

I wish to express here, my very great appreciation to Miss Dorothy Gordon, of the Central Pathological Laboratory, Peking Union Medical College, for her great care in the difficult preparation of the slides.

A complete bibliography of the literature as given in the *Index Medicus* since 1879 and the *Quarterly Cumulative Index*, is appended. The articles which are starred have been available for this review. To this list are added a few other references quoted by some of the indexed authors.

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COMPENSATORY HYPERTROPHY OF THE FIBULA

By ALEXANDER GIBSON, F.R.C.S.(Eng.), Winnipeg, Manitoba

IN recent literature on the surgery of bone, there is considerable reference to "Wolff's law." Innumerable laboratory experiments have established the fact that growth of bone varies with the need for it. It is probably a general law that growth of every tissue in the body is proportionate to the demand made upon it, at least when the change is gradual. This is certainly the case with fibrous tissue, as may be seen in the elongated, enormously strong capsule of an old-standing congenital dislocation of the hip joint.

The case to be related provides such an experiment *in corpore vivo*, and as it shows an extreme degree of natural adaptation to requirements it seems worth placing on record.

No discussion of the interesting subject of the mechanism of hypertrophy will be undertaken, except to suggest that it may be possible to work out, on mathematical lines, the rules determining the activity of the osteoblasts, following up the interesting work of Dendy and Nicholson, on the osteoblasts of sponges, demonstrating the extreme sensitiveness of these cells to vibrations. Reasoning by analogy, as Keith puts it, "Osteoblasts at all times build and unbuild according to the stresses to which they are subjected."

N. B., male, age 25, Russian, came complaining of pain and swelling in the right tibia. His history was that, at the age of 12 he got "a cold in the right knee joint," with swelling and pain. Three months later the leg was opened up and took 6 months to heal. Since that time he has been walking upon the leg. He had worked in a general store until the outbreak of the war. He was mobilized with the Russian army in 1914 and served until the withdrawal of Russia from the Allied forces. He came to Canada a year ago. He has been in the habit of walking 5 or 6 miles daily. During the war he had not been actually in the line, but was employed in clerical work just behind the front. He states that on one occasion he took part in a sudden retirement, during which he walked 30 miles in one day, carrying his share of equipment.

On examination the right tibia showed extensive longitudinal scarring. About 3 inches below the upper margin of the tibia a sinus was present, and the surrounding tissue was somewhat inflamed. This was thoroughly opened up and healed uneventfully. The tibia was observed to be dislocated behind the femur. There was considerable instability of the knee joint, lateral and rotatory motion being considerable in the fully extended position. Roentgenograms revealed a very interesting condition.

The lower extremity of the femur is somewhat porotic and the condyles somewhat flattened pos-

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 1. Photograph of patient.
Figs. 2 and 3. Roentgenograms showing knee-joint and bones of leg. Antero-posterior and lateral views.

teriorly. The patella is also rarefied and about half its mass lies distal to a tangent to the condyles at right angles to the shaft of the femur. The tibia shows an ununited fracture just below the middle of the shaft. The fragments are conical and are completely separated from one another. The plane of the upper surface of the head of the tibia is inclined about 50° to the horizontal. The anterior and posterior portions are rarefied. The central portion is slightly depressed, makes contact in the extended position with the posterior aspect of the condyles, and this part of the bone shows distinctly greater relative density. The lower extremity of the tibia is much rarefied, particularly in relation to the medial malleolus. The plane of the distal surface of the tibia is inclined from above downward and outward about 15° to the horizontal. The fibula shows definite hypertrophy. The upper extremity projects proximal to the upper surface of the tibia. The head itself is little, if any, larger than the normal fibular head. The shaft retains, on the whole, its characteristic outline, although it is enormously thickened, and shows some backward convexity. Both cortex and medulla are increased in dimensions, notably the former. The anterior segment of the shaft shows cortical bone more than twice as thick as the posterior segment, i.e., it demonstrates the usual buttressing along a concavity. At the junction of the lower fifth with the upper four-fifths an additional buttress is seen projecting toward the tibia.

For 1 or 2 weeks after his recent operation patient used a cane, but he has now discarded this. During this time he complained of some discomfort at the back of the knee and about the site of the fracture of the tibia. This discomfort has now also disappeared.

Examination of roentgenograms in the light of clinical findings would suggest that the line of weight bearing must run from astragalus to lower extremity of tibia; from there through the inferior tibiofibular syndesmosis to fibula, upward through fibula to upper part of shaft, and from there partly through head of fibula, but mainly through head of tibia to femur. If this be so it will demand hypertrophy of the inferior transverse tibiofibular ligament, of the interosseous ligament, of the posterior ligament of the knee joint, and of the fibular collateral ligament.

It is of interest to speculate regarding the reason for the shape and the "pitch" of the proximal surface of the tibia. One may take it that the primary lesion was an osteomyelitis in the upper end of the tibia, and this may or may not have been accompanied by an effusion into the knee joint. If effusion there was, it cannot have been purulent, but was probably sufficient to permit of some backward dislocation without equal development of the elements of flexion or external rotation.

Thus, when walking was resumed there were three main stresses acting on the upper extremity of the tibia:

1. Posteriorly, the posterior ligament of the knee joint, and the semimembranosus with its fascial reinforcement to the posterior ligament of the knee joint;

2. Centrally, the downward thrust of the body weight transmitted through the condyles;

3. Anteriorly, the pull of the patellar ligament which is ultimately the pull of the quadriceps extensor.

Once the central thrust is displaced from acting in the long axis of the tibia, it becomes a shearing stress. If its point of application be displaced in front of the central point of the upper surface of the femur, the strain on the anterior stay becomes much greater than the strain on the posterior stay. Added to this is the fact that the anterior stay is mainly muscular, while the posterior stay is mainly ligamentous.

Now muscle is more extensible than ligament, as is seen in the anterior stay itself by the practically unchanged length of the patellar ligament. Hence while the posterior margin is anchored by the strong posterior ligament, the anterior margin is less completely anchored. This may account, to some extent, for the shape of the upper surface, although it is only reasonable to suppose that the original operation attacking the metaphyseal region from the front may have damaged the epiphyseal cartilage, and thus interfered more with the growth of bone anteriorly than posteriorly.

As regards treatment of the condition, patient was advised to carry on as long as possible. A bone graft to bring about union in the tibia is not called for, and on account of the large amount of scar tissue would probably be a failure.

Another measure which may have to be considered at a later date is an attempt to arthrodese fibula to femur. The only alternative would be amputation.

Hypertrophy of the fibula has been seen not infrequently in cases of permanent non-union of the tibia, the result of gunshot wounds in the late war. Such hypertrophy is seldom as pronounced as in the case herewith reported. In this case there is a double deficiency. The non-union of the tibia is backed by a posterior luxation at the knee joint. This twofold increase of stress, coupled with the fact that it dates back to childhood when bone is much more plastic than in adult life, probably accounts for the remarkable picture presented.

TRACTION FRACTURE OF THE LESSER TROCHANTER

By J. FREDERICK LANGDON, M.D., F.A.C.S., Omaha, Nebraska

BECAUSE of its rarity, rather than because of any diagnostic or therapeutic problems involved, the following case is reported:

A boy, age 12, came under my observation October 3, 1919, with the following history: While running home from school, suddenly he felt something "snap" in his right hip. He fell down, but was able to get up immediately. He stated that it was painful but not of undue severity. He was able to get home alone, a distance of one-half mile. He said his leg dragged, so much so that he had to take hold of his thigh with his hands and pull it forward in order to take a step. On arriving home, he complained of some pain, but his mother stated that he did not cry or make much fuss about it.

I first saw him 3 days after the injury. At that time, his mother stated that the boy was having no pain, but was not walking properly. On asking him to walk, he proceeded in a very unusual manner. He stepped forward on his left foot, then grasped his right thigh with his hands and drew it forward, after which he would bear his weight on the injured leg without any apparent pain, again stepping forward with the left leg. In this manner he crossed the room, stating that he felt no pain at all. Further examination revealed no swelling or discoloration about the hip joint or thigh. Deep pressure in Scarpa's triangle elicited pain, but not severe. There was no shortening of the limb. On lying down, the leg assumed a position of slight external rotation. Passive movements were normal in all directions, and not painful. The great trochanter was in Nelaton's line. The predominant sign seemed to be loss of active flexion of the thigh. When standing or reclining, the patient was unable to flex the thigh. Also, while sitting down, he was unable to raise the limb from the horizontal position (Ludloff's sign). Patient was removed to St. Joseph's Hospital, where an X-ray photograph showed a separation of the epiphysis of the trochanter minor.

Patient was put to bed and a plaster-of-Paris cast applied, immobilizing the hip and knee joints. The limb was placed in slight flexion and abduction. At the end of 3 weeks, the cast was removed and the patient allowed up on crutches, which were discarded at the end of 2 weeks. At the end of 6 weeks, the patient was discharged, restoration of function being complete.

In a thorough search of the literature, I am able to find only 24 cases reported up to October 1, 1921. Ruhl (1), of the Frankfort clinic,

Fig. 1. Roentgenogram showing detachment of lesser trochanter, taken October 3, 1919.

Fig. 2. Roentgenogram showing complete healing, taken January 16, 1922.

recently states that, after an exhaustive study of the literature, he is able to find only 22 cases, including his own. Poston (2) mentions two cases, one of Usland and one of his own, which he gives in detail. This brings the record up to 24 cases, mine being the twenty-fifth.

ETIOLOGY

Ruhl's statistics show that 77.3 per cent occur between the ages of 10 and 20, the period when youth is particularly physically active. At this time, ossification is not complete, predisposing to epiphyseal separation. The essential etiological factor is sudden strain on the ilio-psoas muscle. This muscle is primarily a flexor. Its function is to draw the thigh and trunk together. Acting from above, it flexes the thigh, acting from below, the femur being fixed, it bends the trunk forward. The fracture under discussion occurs when the body is suddenly thrown backward in such a manner that its whole backward weight is thrown on one leg with a resulting sudden strain on the corresponding ilio-psoas. This muscle, in its efforts to right the body, undergoes a violent reflex contraction, with consequent detachment of the lesser trochanter. Feinan (3) expresses the belief that the production of this injury lies in the sudden backward strain thrown on an actively contracted ilio-psoas. He cites a case in which a patient falling forward suddenly threw his body backward, fracturing the lesser trochanter. However, a study of the history of the reported cases apparently indicates that in the majority of cases, at least, it is the reflex contraction of an overstretched ilio-psoas that is the causative factor. On this basis, our patient probably suffered his injury in the following manner: While running, as the result of slipping or stumbling, his body was suddenly thrown backward. In attempting to regain his balance, the whole weight of his body was thrown on one leg, his right leg. The right femur being fixed, the iliopsoas, by a sudden violent reflex contraction, attempted to flex the bent back trunk on the thigh. The trochanter minor was unable to stand the strain and was detached violently from the shaft.

SIGNS AND SYMPTOMS

Loss of active flexion of the thigh—partial or complete—is the predominant sign. Ludloff made the observation that, with the patient in the sitting position, flexion of the affected limb is impossible, though with the leg extended and the patient recumbent, flexion may be possible. The ability of the patient to flex the

limb when lying down is possible according to Ruhl, owing to the fact that in this position the rectus femoris and tensor fasciæ femoris may in some cases be of sufficient strength to produce flexion without the aid of the iliopsoas. Passive movements are usually possible in all directions. Such movements generally are painful, though in some cases the pain is not marked. In all cases there is pain elicited on pressure, in Scarpa's triangle. Swelling may or may not be present, depending mainly on the damage to the soft parts. Pain on walking is recorded as a constant symptom. The gait is affected in all cases, but usually not to any marked degree. Most of these patients are able to walk though with pain and a limp.

DIAGNOSIS

Before the advent of the X-ray, most of these cases were diagnosed fracture of the neck of the femur. With a typical history and loss of active flexion, especially in the presence of a positive Ludloff sign, the diagnosis is rarely in doubt, though the ultimate confirmation must rest with the X-ray.

TREATMENT

Treatment is simple and effective. Ruhl has shown that the origin and insertion of the iliopsoas are nearest each other when the femur is in slight flexion, outward rotation and abduction. The limb should be put in this position and fixed by means of sand bags, splints, or plaster cast. It should be thus immobilized for from 2 to 3 weeks, after which time, patient may be up on crutches. These may be discarded in from 1 to 2 weeks' time. The results are uniformly good, all cases having been reported as cured.

SUMMARY

The case herein reported differs in some respects from other cases hitherto published. Marked pain was conspicuous by its absence. At no time did it occupy the foreground in the clinical picture. When I first saw this patient 3 days after the injury, though loss of flexion was absolute, nevertheless he could bear his weight on the injured limb without any evidence of pain. Passive motions were possible in all directions and not painful. Loss of flexion in this case seemed to be more marked than in the cases previously published. Ruhl notes that the gait is only slightly affected in most cases. This, no doubt, is due to the fact that the iliacus portion of the ilio-psoas has an attachment to the shaft of the femur for a distance of 1 inch below and in front of the lesser trochanter, and by means of this attachment varying degrees of flexion are possible. In my case, the probabilities are that the complete attachment of the muscle to the shaft was torn away, together with the trochanter, resulting in total loss of flexion.

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DEPARTMENT OF TECHNIQUE

TWO KINEPLASTIC PROBLEMS SOLVED

By Dr. GUILLERMO BOSCH ARANA, Buenos Aires, Argentine
Professor, Faculty of Medicine
Dr. DELFOR DEL VALLE, Buenos Aires, Argentine
Professor, Faculty of Medicine
AND
Dr. F. WILDERMUTH, Frankfurt, Germany
Privatdocent

WHEN in the month of July, 1917, I performed my first kineplastic amputation of the forearm, I did not imagine that it would yield encouraging results, as the method was so different from all prescribed methods. Later, more serious study, constant attention to the subject, and new cases convinced me of the great value of this means to secure better results than could be obtained by the ordinary methods. However, in order to overcome the standard opinions regarding the old fashioned, maiming methods, an atmosphere had to be created in favor of kineplastic amputation and results had to be produced to show the soundness of its principles.

Lack of faith in, and disdain for, the method, which is still in an evolutionary period, had its *raison d'être*, and it was logical that pioneer workers in the field should show results which were irrefutable, since a kineplastic victory meant a radical modification of old ways and means which had withstood the tests of time and experience. The campaign must needs be a strenuous one, not only because of the difficulty of securing patients in a city which is not a manufacturing one, but also because the prosthetic problem must be studied and solved in its entirety with the object of obtaining perfect results. To add to our difficulties there was very little to be found in the literature regarding the subject, and what articles were found described methods and apparatus very inadequately. This in addition to the lack of serious study of the problem of orthopedic mechanics helped to dampen the optimistic outlook which I had indulged in at this time.

The correspondence that I had carried on with Professors Vanghetti, Putti, Pellegrini, and others—Italians by birth as was the method—encouraged me to continue with the work, and their commendation of my endeavors encouraged me greatly and I felt compelled to accept their trust in my ability and go on, for I believed that success would crown my efforts. The description of the work that I had already done and the results as published by me brought about a great and hearty welcome from my distinguished colleagues. For this reason I do not believe it is necessary to describe here the governing principle nor the basis of kineplastic amputation which is known to every surgeon, but I shall limit myself to giving the latest progress made in solving the problem. Kineplastic amputation has won an indisputable place in the domain of surgery. Today no one can question its well-earned and tangible results. It remains for the future to perfect such results in their surgical and orthopedic aspects. Time can neither destroy nor impair what progress has been made, and this is especially true as the question involves problems of social, moral, and material interest.

The surgical technique which offers the greatest advantages, on account of its simplicity, is that proposed by Professor Pellegrini. Professor Pellegrini employs a skin-bridge and secures a first-class kinetic motor with the advantage that it works in any part of the system. Extrasegmental motors may be constructed to the side and transfer of power is effected from one part to another. A cicatrix is obtained at first, without destruction of bones or mutilation of other parts, and the patient is spared from suffering greater functional disability as he is provided with a common prosthesis. Simple, local, infiltrative anæsthesia may be used.

In spite of its advantages there are drawbacks to the method in that it is difficult to secure a motor of sufficient size, for the procedure pro-

Fig. 1. Double kineplastic amputation of the forearm

duces a tunnel the diameter of which in no case may be larger than that of an ordinary pencil. Today we know that the larger and freer the eye of the motor, the better it will work. In other words, the pressure exerted by the prosthetic apparatus in its hold upon the skin of the tunnel will be better resisted by the skin when the surface to be adapted is large; that is to say, the larger the eye, the better the orthopedic results, because there is not the risk of ulceration of the skin and the pull is distributed over a greater skin surface. However, this drawback is not a serious one, since with good management in the re-education of the maimed individual and moderation in prosthetic exercise, tolerance and sufficient adaptation of the skin to the pressure caused by the connecting apparatus, are obtained.

My distinguished colleagues can appreciate what I have just said by observing the patient upon whom such an operation was done and who was furnished with a suitable prosthesis which he has worn now for 2 years.[1] In the early months

[1]Bosch Arana. Surg., Gynec. & Obst., 1922, xxxv, 319.

Fig. 5. Kineplastic stump. *I*, Elbow (olecranon); *II*, arm; *III*, forearm (stump); *IV*, skin from abdomen; *V*, motor with a tube inserted in its roomy eye.

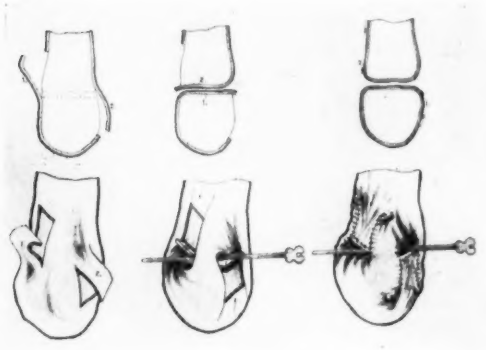

Fig. 2. Fig. 3. Fig. 4.

Figs. 2, 3, and 4. Diagram showing steps in operation in making skin tunnel.

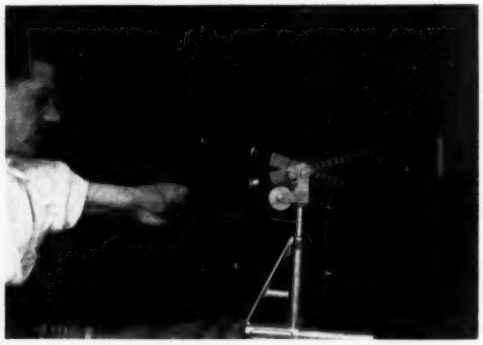

Fig. 6. Potential yield from motor: 15 kilos with run of 4 centimeters measured with author's ergograph.

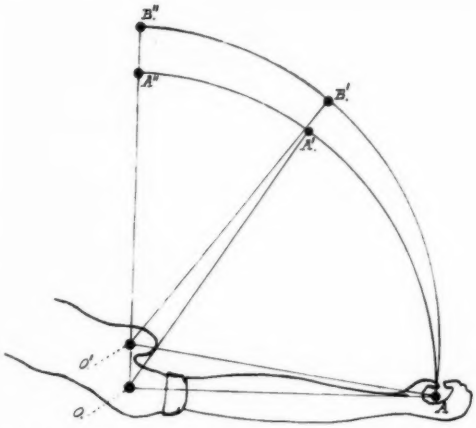

Fig. 7. The prothesis problem. *O*, Center of elbow; *O'*, center of motor; *A A''*, circumference of center *O*; *A B''*, circumference of center *O'*.

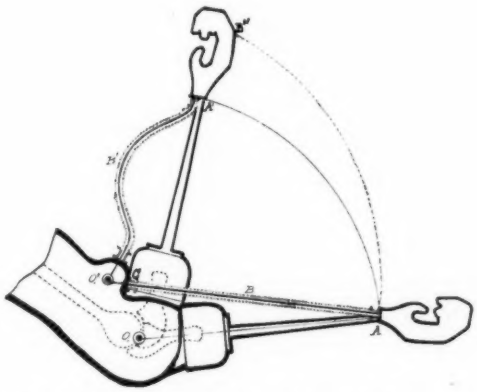

Fig. 8. Bowden. *O*, Center of flexion of elbow; *O'*, center of motor; *B*, Bowden.

the patient used the motor discreetly and conscientiously, since by overdoing in his manual work, he suffered pain and discomfort, and irritation and intolerance of the skin, which he was careful not to increase, removing the prosthesis and allowing the motor to rest. In the course of time, however, he was able to work for longer periods, and the tolerance of the skin became greater, so that now, the patient is able to do continuous and efficient labor without inconvenience.

Another drawback to the procedure is the making of motors which have limited power of movement, because the motor is not free as are the terminals. It is a sufficient estimate of the power of my patient's motor to say that the cicatricial process must fix the motor to the neighboring or adjacent tissues, and its freedom of motion will be diminished by these factors. Hence, it is advisable to begin active movements a few days after operation, in order to avoid injurious scars which might fix the motor to the tissues near, in a permanent or stable fashion. A terminal motor has greater freedom of motion and by exercise is inclined to improve in power and in extent of action.

Nevertheless and notwithstanding the circumstances stated, I feel satisfied with the Pellegrini operation; I believe that it is as excellent and that it is perfectly feasible to secure with it the end being sought, and such is the verdict of the patient himself, photographs of whom I present.

We will pass now to the other patient (Fig. 1) who suffered a double amputation of the forearms, and was provided with side motors which had the same function as end motors. From this case we shall be better able to judge of the superiority of the latter over the former. The motors have been constructed according to the technique described by Professor Sauerbruch. The motors work more slowly and with greater difficulty; their construction requires two or more surgical operations, and the technique of the skin plastic operation must be modified to suit the individual case.

The motors are made of the "muscular masses," the "power masses" being made in the first stage of the operation—the muscular protuberances, as Sauerbruch styles them—and they represent the future kinetic motors. In the sceond stage of the operation, the surgeon makes the motor eye, and effects its epidermization, thus transforming the "power mass" into a "kineplastic motor." For this purpose, the skin plastic is planned according to the disposition of the "power masses," and the suitability of the clinical case.

For our patient, Dr. del Valle built up in both forearms in the first stage of the operation, "power masses" out of the supinator muscles, the round pronator, sacrificing the deep muscles in the region as he considered them useless for the construction of the motors, and, as is natural, it was found necessary to cover over the stump surfaces with abdominal skin, by means of pendent tissues with pedicles. Once the power protuberances were obtained, then tunnelization was effected, by means of a technique which will be best understood by studying the schematic drawings (Figs.

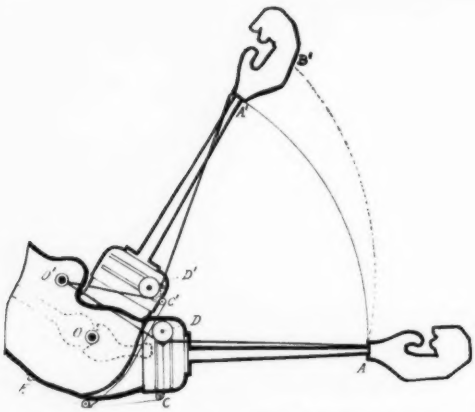

Fig. 9. Differential. *O*, Center of elbow; *O'*, center of motor; *D*, differential.

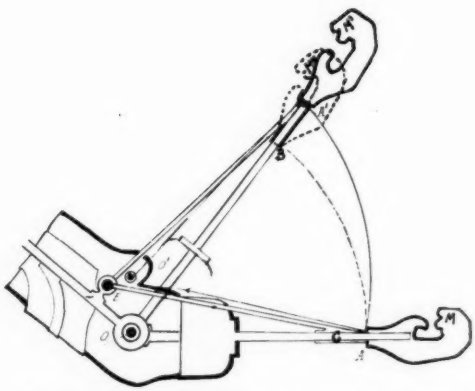

Fig. 10. The problem solved. *O*, center of elbow; *E*, center of motor; *O'*, motor; *A-B*, circumference of center *O; A-A'*, circumference of center *O; E-A*, stiff rod which propels the hand and causes it to slip along the axis; *B-A'*, distance gained.

2 to 4). The transplanted tissue grew without any difficulty, and 6 weeks later motor exercises were begun as well as the re-education and training of the muscle. The artificial hands were ordered from the Rizzoli Institute at Bologna, by favor of, and through, Professor Putti, director of the establishment.

As you may perceive, the quality of the motors is first-class so far as the mechanical construction is concerned—they are free and easy to manipulate, and besides the motor eye is of sufficient size to admit the index finger of my hand (Fig. 5) completely and easily. The kinetic power as measured with my ergograph shows a run of 4 centimeters with 15 kilograms weight—an exceptional result, which it would be difficult to obtain with Pellegrini's technique for the reasons given. In our motor the run is free from hindrances or cicatricial bridges, and it acts as do those of terminal pattern (Fig. 6).

The second part, or hand prosthesis, was adapted to the patient, the arm and forearm bracelets being constructed in the orthopedic workshops of the Public Assistance, whose intelligent director is Dr. Wildermuth, and through whose active help and assistance all difficulties were obviated. He collaborated efficaciously in the solution of highly interesting problems, as he had had training in orthopedic matters in German clinics and under the direction of Professors Bethe and Sauerbruch.

The problem of kineprosthesis was presented in its most difficult form in our case, as the motor was situated upon the forepart of the arm at the bend of the elbow. Surgeons universally agree that the construction of motors within the folds of the bend of the elbow is contra-indicated, for in such a position they would hamper the freedom of articular movements, since in maximum flexion movement would be hindered and the kinetic value of the motor destroyed. Notwithstanding this fact with which we were familiar before operating upon our patient, but relying on our clinical experience, we undertook the task and made a motor in spite of what our success might be; for we were well aware that the subject of kineplastic amputations is still in the experimental stage, that old methods are being revised, and new ones devised and that it is no longer possible to trust to precepts which we hitherto thought incontrovertible, even though such precepts were enunciated by masters of high standing and renown.

When the prosthetic apparatus had been made and fitted to our patient, the outer tractor of the hand was tightly stretched and joined to the kineplastic motor in the extended position. The patient was made to lift a wine glass which was taken hold of with the hand through contraction of the motor, and at the same time he was told to raise it to his mouth. In doing this, with the forearm half bent, the wine glass fell to the ground and broke to pieces. The patient said the glass fell because it had become loosened from his grasp, although the motor was taut or contracted.

In studying the case we soon realized that in bending the forearm, the distance between the motor and the hand was shortened; consequently, the tractor loosened and the fingers half opened

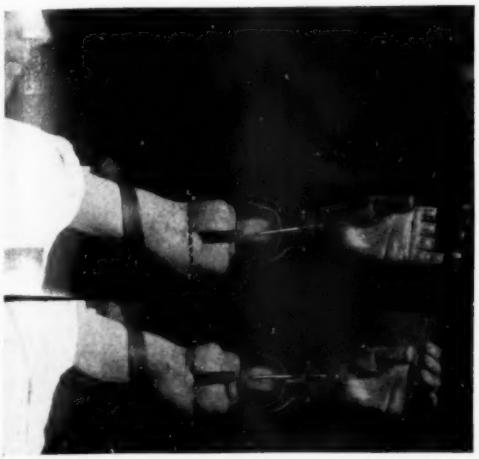

Fig. 11. Active flexion of the hand. Note displacement of the motor which is placed in the axis of flexion.

and the glass dropped. Figure 7 shows, in a graphic form, the problem presented. It is manifest that the center of the elbow-bend O, does not correspond to the center of the motor O', which is higher up, its position depending on the distance between O and O'. In describing an arc of a circle the radius of which, OA, represents the length of the forearm, it is natural for the hand to take the positions OA' and $OA'A''$. On the other hand the center of the motor O' and its tractor, represented by the distance $O'A$, should follow the circumference $AB'B''$, with its center in O'; but as the hand is placed on A'' and not on B'', it follows that a slacking of the tractor ensues equal to the shortening of the distances OA' and $O'A''$, the differential index of which represents the distance $A''B''$.

The hand half opens and drops the object held because the outer tractor relaxes in spite of the fact that the motor still remains contracted. In synthesis, the problem should be solved by shortening the outer tractor, in a manner correlative, simultaneous, and in proportion with the flexion of the forearm. This adjustment should not therefore reduce the power of the motor nor make it less efficacious.

The elementary formula, which may be stated in the following words, the work is equal to the power multiplied by the distance covered, applied to the case, would show us that to obtain the same amount of work from the motor, we need only adjust the mechanism according to the variable element of the formula—the distance—

Fig. 12. Prothesis furnished to patient. (Rizzoli Institute, Bologna.)

since the motor must produce the same return in work. Any solution of a prosthetic problem which tends to reduce the motor power must be condemned.

In our first trial we used the mechanical appliance of the "Bowden" (Fig. 8) with a flexible willow tube B, fitted as shown in the sketch and fixed at both ends A, C. Within the tube runs the external tractor which joins the motor to the hand. It is easily understood that in flexion, the tube will bend correlatively with the shortening of the distance OA and OA', taking the curve indicated in B', and covering the difference $A'B''$.

The trial turned out badly in that the motor lost power because of friction of the external tractor inside the curved tube B, and the hand had not enough strength to grasp objects. Afterward we tried a mechanical appliance (Fig. 9) known as the "differential" which consisted of a little wheel the center of which, D, turned on a groove, being tied to the arm with a flexible but inelastic cord $D\ C\ F$. In producing flexion, the little wheel D slipped along the groove, and took the position D', gaining the difference C, D,

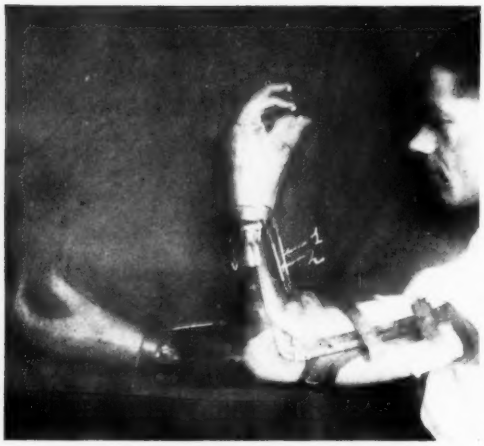

Fig. 13. Movement of flexion and extension of the prothesis, where the active flexion of the hand may be seen in any position. (While "posing," the patient closed his hand, and bent it.)

since it is placed in $C'D'$. This contrivance did not prove to have advantages over the previous apparatus, since angulation of the external tractor rendered the motor power useless and the motor lost much potential energy.

Because these two possible solutions failed, we undertook a thorough study of the problem, and several months passed without reaching a solution.

From another viewpoint the problem may be stated as follows: If it is not possible to shorten the external tractor, why not lengthen the axis of the forearm and gain the difference by means of propulsion of the hand during forearm flexion? The idea was an attractive one and we believe it is new and original with us. Therefore we set about our task enthusiastically, and after various attempts we succeeded in constructing an apparatus as shown in Figure 10.

The principle on which the apparatus is made is based on the log line or slide valve which consists of two pieces of material which dovetail one into the other, and which slide one on the other. When the forearm is bent, the hand must move from the center of the bend of the elbow. In this way the difference in distance is overcome, the distances remaining the same from the center of the kineplastic motor, that is, the external tractor constantly exerts the same tension, and the motor is able to produce normal action without losing either in power or in distance traversed.

In other words, in moving the hand it adjusts itself by describing a circle the radius of which corresponds to that of the motor. Thus we see that the curve of the hand does not correspond to the natural or physiological one but is rather the curve of the center of the kineplastic motor.

In Figure 10 one may observe that the axis of the forearm which holds the hand, in bending, will carry the latter to the position M (it must really be in the place of the dotted line M'') for the circumference of the elbow corresponds to the curve AB, and in no way to the curve $A.1'$ which is that made by the hand with its axis corresponding to E, the center of the kineplastic motor.

In spite of the fact that according to the figure, the center of the motor O' does not correspond to the center E of the curve made by the hand, we must not forget that during the contraction of the motor, its center or eye O' is displaced toward E and occupies the same place.

The propulsion of the hand is given by the little rod $F\ A$ which is rigid and solid with the hand, and the sliding is effected with the appliance called the slide valve C.

Flexion of the forearm is effected normally with the biceps. It is worthy of mention that with the appliance adopted, the kineplastic motor does not alter its power or run and the apparatus is just as powerful whether in the extended position or in that of greatest flexion. The hand moves from or draws near the normal axis of the elbow and the relative distance is maintained permanently and works with the kineplastic motor and its external tractor; consequently, the bending of the fingers is constant and does not vary as to power and fulness.

The solution of the problem as done by Dr. Wildermuth (Figs. 11 and 12) cannot be improved upon as it preserves all the advantages of the kineplastic motor during flexion of the hand. It allows us to modify our old ideas regarding kineplastic surgery, ideas which we believed fundamental and stable, and it opens up a wide field in surgery in the construction of motors adjacent to or upon the folds of the articular surfaces—plastics which hitherto have been considered contra-indicated because of the serious difficulties encountered in placing suitable prostheses.

Figure 13 shows the patient with the prosthesis applied. It shows that the action of the motor is permanent and stable in any position of the forearm, whether bent or extended; its position in the bend of the elbow does not affect its run or efficiency; and if to this we add that its power is 15 kilograms over a run of 4 centimeters, I believe we are justified in stating that we have overcome

one of the gravest and most serious difficulties in kineplastic amputation, and that we have triumphed brilliantly.

Let us not forget that the length of the forearm segment was 9 centimeters, that is to say, the indispensable minimum for the placing of an ordinary prosthesis, and that the motor was constructed with the remaining muscular portions of this region (supinator and round pronator) and the results, both surgical and orthopedic, have crowned our hopes and patient labors with success.

Our patient, who suffered double amputation, can now perform the necessary acts of daily life: he feeds himself, does many other things necessary in his personal care, exercises himself freely, and not only has he resumed many of his usual habits, but also he has regained his manly spirit, his personality, and his sense of honor. He is quite a gentleman!

THE UTILIZATION OF THE RUBBER CATHETER IN INTESTINAL ANASTOMOSIS[1]

By EDMUND J. HORGAN, M.D., F.A.C.S., Washington

THE use of a mechanical device to keep open the lumen of the intestine following suture dates back to medieval times. Lanfranc, in the thirteenth century, advised the use of a "pipe of elder" for this purpose, and it is likely that his contemporaries, following his teaching, used it in many instances. Intestinal suture was only practiced in those days in cases of injury. No description of resection of the intestine, if performed, has been left on record. From the thirteenth century until Lembert, in 1826, described his method of suture, no progress was made in intestinal surgery and from his time until the introduction of the aseptic suture by Lister, the development of intestinal surgery remained for the pioneers of the antiseptic and aseptic era. Resection of the intestine with end-to-end anastomosis by suture was accomplished and described by Halsted and others. Since the introduction by Halsted in 1887 of his method of intestinal anastomosis there have been many modifications of his technique.

When it becomes necessary to resect the intestine for tumor, an inflammatory process, adhesions, stricture; gangrene due to obstruction, strangulation, thrombosis, or volvulus; or to repair incised, lacerated or perforated wounds; or to close a fistula, the resected intestine should be removed in such a way that the circulation will be preserved in the adjoining segments and the tissues traumatized to a minimum, preventing œdema, infection, gangrene and necrosis, and the anastomosis or repair should be made so that the edges are evenly inverted and approximated and held by suture in such a manner that, during the process of healing, there will be no obstruction in the lumen of the intestinal canal or leakage of gas or fluid through the suture line. All of these requirements cannot be met with in every case. The lumen of the intestine may be so narrowed, following anastomosis or repair, that obstruction may occur from œdema or angulation, and the distention ensuing may cause cutting or tearing out of sutures and may prove fatal by allowing bacteria, gas, or fluid to contaminate the peritoneum. To maintain the lumen in the bowel during the process of union, following suture cylinders of dried intestine, bone, wax and tallow; ferrules of metal; dried trachea and cardboard cylinders had been used and described. Senn in 1888 described several mechanical appliances. He advocated the use of decalcified bone-plates to keep the stoma open in side-to-side anastomosis. In 1891 Robinson described a method of circular enterorrhaphy over a rubber tube 3 to 6 inches in length to overcome this difficulty. Murphy recognized the need of a method of intestinal anastomosis which in addition to other measures of safety, would keep the lumen of the bowel open and allow the passage of gas and fluid through the anastomosis. By his genius he devised a mechanical button for intestinal anastomosis which he described in 1892. Through his teaching, the method was popularized and has had many advocates. The button approximates the proximal to the distal portion of the intestine and maintains an opening. The intestinal wall which is clamped in the button becomes necrosed, allowing the button to lie free in the lumen and pass onward in the fæcal current.

Robson, in 1893, described a decalcified bone bobbin having an adequate opening to prevent obstruction and around which an end-to-end

[1] Presented at fourth annual meeting of the Association of Resident and Ex-Resident Physicians of the Mayo Clinic, Rochester, Minnesota, May 29-30, 1922.

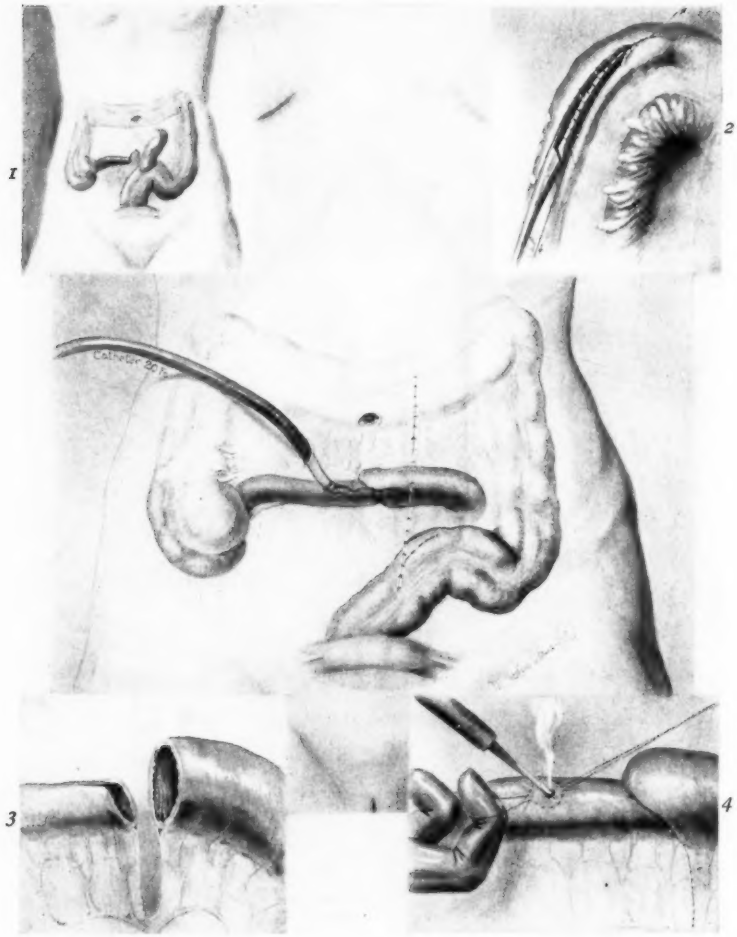

Fig. 1. Case 1052. Illustrating method of using catheter in intestinal anastomosis. Soft rubber catheter passing through abdominal wall, omentum, enterostomy in distal segment of ileum and annulus of anastomosis into proximal segment of intestine. *1*, Divided ileum, with closure of distal segment and ileosigmoidostomy made at a former operation elsewhere, as found upon exploration. *2*, Aseptic inversion and closure of cauterized edges of opening in sigmoid by modification of the Parker-Kerr technique. As curved forceps is withdrawn with blades slightly open, the tips of the blades are depressed, inverting the cauterized edges. *3*, Dilated proximal segment of ileum. Non-distended distal segment of ileum cut diagonally and slit opposite the mesentery to increase circumference of lumen. *4*, Purse-string suture applied and enterostomy being made with cautery by technique of Long.

anastomosis could be quickly made with two continuous sutures. From this date until 1909 no important mechanical device had been described until W. J. Mayo reported the use of a rubber tube three-fourths of an inch in diameter, which was passed upward through the anus beyond the proximal side of the suture line after resection of the sigmoid, in order to allow the escape of gas and fæces so as to prevent impaction and leakage. A year later Balfour reported a technique for anastomosis of the sigmoid and rectosigmoid in which he used a large rub-

ber tube, placed in such a way that it passed from the proximal segment of the sigmoid downward through the distal segment and outward through the anus, the anastomosis being made over the tube. After the first row of sutures has been completed, the tube is anchored by a suture. By traction on the anal end, the proximal side of the anastomosis is invaginated into the distal and the second row is then placed. Mummery, in 1910, described the use of Keith's glass tube in resection of the sigmoid to keep the lumen of the bowel open during the process of healing, and he also mentions the use of a rubber tube for the same purpose.

I wish to describe a method of using a catheter in intestinal anastomosis, which I have employed in a few cases, and which has proved to be of great value. After making an end-to-end anastomosis by suture, if there is a constriction of the lumen or angulation, which will later cause obstruction; or if there is an accumulation of fluid or marked distention of the proximal intestine from pre-operative obstruction, I make an enterostomy in the distal segment of the intestine, and pass a catheter (Eynard-Wishard Model—20 Fr.) having 6 to 8 lateral eyes, into the enterostomy opening, through the annulus of the anastomosis and into the proximal segment. I can best illustrate this by the following case:

Case No. 1052. Miss A. N. P., a secretary, single, age 27, presented herself for examination July 20, 1921, complaining of pain in both lower quadrants of her abdomen, headache, backache, and swelling of legs. Four years ago she had an "irritating" pain on the left side of her abdomen for which she was operated upon and the appendix removed. This did not relieve her. The pain remained as before. One year later she was operated upon again. At the second operation the ileum was divided and the proximal segment anastomosed to the sigmoid; the distal segment was closed. Since this operation she has suffered from gas, a dull pain in both lower quadrants of the abdomen and backache. Headache, which is frequent, has a relationship to the trouble in the abdomen. At times she has nausea and vomiting. Eating causes marked abdominal distress and fullness. "Knots" form on both sides of the abdomen. She is markedly constipated and it is necessary to take a laxative every night. Bowel movement from laxative or enema does not give much relief. Her feet, ankles, and legs swell. During the past six months she has lost 20 pounds.

Upon examination the abdominal wall was found to be relaxed. The colon which was filled with hard masses of fæces could be palpated and outlined from the cæcum to the sigmoid. Urinalysis showed an acid reaction, specific gravity 1,030, faint trace of albumin, indican, many epithelial cells, leucocytes, and bacteria. The leucocyte count was 9000. A diagnosis was made of impaction of the colon from analstasis, following a division of the ileum and ileosigmoidostomy at a former operation elsewhere.

Operation September 28, 1921. (Province Hospital, Case No. 116,982.) Upon exploration through a left rectus incision, the ileum was found to be divided about 6 inches from the ileocæcal valve. The proximal segment which was markedly distended was found to be anastomosed into the side of the sigmoid, the distal segment which was closed, was found to be small and collapsed. The colon was filled with hard fæcal masses. It was decided to cut off the ileosigmoidostomy and to re-establish the continuity of the ileum. Two clamps were placed along the anastomosis and the ileosigmoidostomy was cut off with a cautery between the clamps. The opening in the sigmoid was closed by using a modification of the Parker-Kerr technique. The closed end of the distal segment of the ileum, which was collapsed, was opened by cutting it obliquely, and a longitudinal slit one-half inch long was made opposite the mesentery to increase the circumference of the lumen. Continuity of the ileum was re-established by an end-to-end anastomosis. When the anastomosis was completed it was found that the annulus of the anastomosis was small, and that there was danger of an obstruction occurring at this place later. To prevent this an enterostomy was made in the distal segment of the ileum with a cautery, by the technique of Long, and into it a catheter (Eynard-Wishard Model—20 Fr.) having six lateral eyes was inserted and passed through the annulus of the anastomosis into the proximal segment of the ileum. The catheter was fastened into the intestinal wall by infolding with a suture. The open end of the catheter was passed through a small opening in the omentum, made by thrusting a blunt forceps through it. Through a stab wound in the abdominal wall, the catheter was withdrawn and tension made upon it until the intestine, with the omentum interposed, was pulled up to the parietal peritoneum. The bell end of the catheter was clamped during this procedure to prevent leakage.

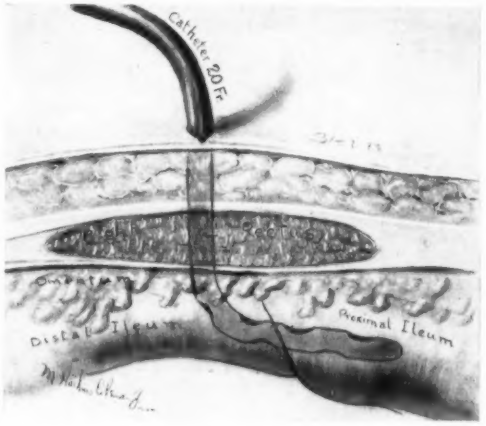

Fig. 2. Cross section of the abdominal wall showing soft rubber catheter in position. C. H. Mayo method of enterostomy employed. Catheter passing through stab-wound in abdominal wall, omentum, enterostomy opening in distal segment of ileum, annulus of anastomosis and into proximal ileum.

Postoperative convalescence. Twenty-four hours after the operation the clamp was removed from the catheter; gas and fluid escaped freely. About the fourth day the colon began to empty and the patient suffered considerably for 36 hours, while the hard fæcal masses were being expelled. After the colon emptied, drainage through the

catheter diminished. A clamp was kept on the catheter part of the time. On the seventh day drainage through the catheter had stopped and it was withdrawn. The enterostomy stab-wound through the right rectus muscle closed a few days later and convalescence continued without incident.

Charles H. Mayo and Victor Bonney have each called attention to the value of enterostomy as a life-saving measure in postoperative intestinal obstruction and paralytic ileus, and it is now a well-established surgical procedure in these conditions. In cases where I have anticipated intestinal obstruction, I have used a catheter in making an enterostomy at the time of operation as a precautionary measure, and I think it has been a factor in preventing postoperative obstruction. This practice of making an enterostomy as a measure of safety was the motive which prompted me to use it in the cases of intestinal anastomosis where I anticipated an obstruction. Without discussing the relative merits of making the enterostomy in anticipation of, or after the occurrence of obstruction, I wish to outline the value of the catheter in intestinal anastomosis.

1. It prevents obstruction from œdema, with closure of the lumen in the suture line, by keeping open the annulus of the anastomosis.

2. It acts as a drain, from the proximal to the distal segment, if there is angulation of the anastomosis or of the intestine within a few inches of the suture line.

3. It prevents distention by allowing escape of gas and drainage of fluid contents from the intestine.

4. It prevents peritonitis from the tearing out of sutures and separation of sutured edges by distention of intestine with gas and fluid.

5. Following resection for thrombosis or obstruction, the catheter, in addition to keeping the lumen of the intestinal canal open, will quickly drain off toxic substances which have accumulated.

In conclusion I would say that the advantage of this method of making an enterostomy in the distal segment of the intestine with a catheter, and the passage of the catheter through the annulus of the anastomosis into the proximal segment, offers a means of overcoming the dangers which lead to a fatal issue following suture of the intestine.

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A DEVICE FOR HÆMOSTASIS AND DRAINAGE FOLLOWING SUPRAPUBIC PROSTATECTOMY[1]

By JOHN H. CUNNINGHAM, M.D., F.A.C.S., Boston

HÆMORRHAGE, associated with suprapubic prostatectomy, originates from three sources: the prostatic capsule from which the gland is enucleated, the torn edges of the mucous membrane at the bladder outlet, and from the incision in the bladder wall.

A few operators believe that only the bleeding from the bladder wall incision requires attention, and are satisfied to disregard the bleeding from the prostatic capsule and torn edges of the bladder mucous membrane, simply controlling the bleeding from the bladder incision, by its closure by suture, about a suprapubic tube. Others, however, lay stress upon the bleeding from the torn edges of the bladder mucous membrane, incident to the enucleation of the gland, and advise careful suturing of these mucous membrane edges to prevent bleeding, which may occasionally be serious. Others feel that there is also real danger from hæmorrhage from the prostatic capsule, and for that reason either pack the prostatic region with gauze or employ a rubber bag, such as that of Hagner or Pilcher, for the purpose of arresting such hæmorrhage.

Personally the feeling is held that the source of the most dangerous hæmorrhage is from division of vessels in the incision of the bladder wall, not recognized and controlled by suture at the time of operation, yet hæmorrhage of a likewise serious character may arise from the free edges of the torn bladder mucous membrane, incident to the removal of the prostate, and that the ooze from the prostatic capsule is rarely of a serious nature, provided the enucleation has been properly carried out, and the prostatic capsule unruptured, and the vessels within it uninjured.

After a considerable experience in suprapubic prostatectomy without attention to hæmostasis, other than careful suture of the bladder-wall incision, I am convinced that in the majority of cases serious hæmorrhage is rarely an incident requiring attention; but, on the other hand, there have been many instances following such a procedure which cause worry, and in which a secondary operation to control hæmorrhage has been occasionally required. Particularly is this true of the smaller glands with much fibrous tissue, and those which extend upward under the trigone. Personally I have come to the conclusion that bleeding from all possible sources should be controlled as much as possible to conserve the patient's strength.

It being generally admitted that prostatic patients, as a class, are poor surgical risks, reasonable rapidity in operation and conservation of the patient's vitality in all ways, are important factors in lowering our mortality statistics. Lessening all bleeding incident to operation certainly is a factor to be taken into consideration in this connection, and I have come to the conclusion that bleeding from all sources should be controlled as thoroughly as possible.

My feeling in regard to suturing of the torn edges of the mucous membrane at the vesical outlet is that it is a procedure requiring an operation of increased magnitude, and is time consuming to the point of making it a questionable routine procedure on this account. Packing the prostatic region and compressing the torn edges of the mucous membrane by gauze, while not time-consuming, invites phosphatic deposit, in the presence of an alkaline urine, and its removal is a

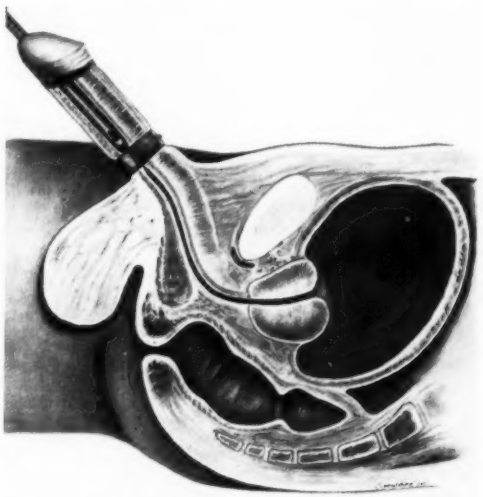


Fig. 1. Drawing showing bladder distended. The catheter following the bladder distention, withdrawn into penis; urethra compressed by a special clamp to retain the fluid in the bladder.

[1] Read before the New England Surgical Society, Burlington, Vermont, September 23 1922.

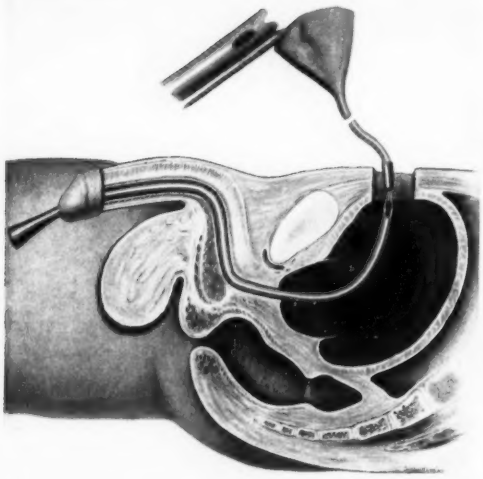


Fig. 2. Drawing showing the suprapubic cystotomy wound; the prostate removed; the free edges of the torn mucous membrane about the bladder outlet. The penile clamp has been removed; the catheter pushed into the bladder and out the suprapubic incision, the penile tube of the hæmostatic bag is attached to the catheter. By withdrawing the catheter through the urethra the bag is drawn into the prostatic region and the suprapubic drainage tube, attached to the inflating tube of the bag, is brought to a proper position and maintained without further adjustment.

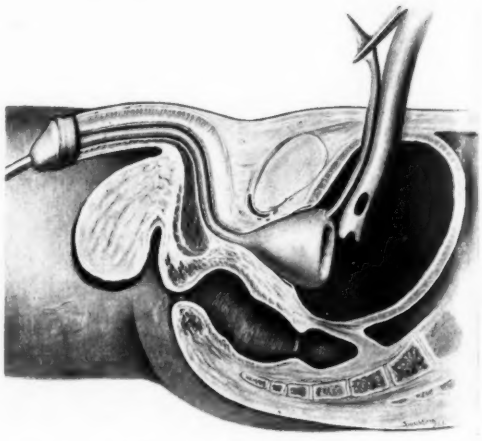


Fig. 3. Diagram showing hæmostatic bag located in the prostatic region, having been inflated by a syringe full of air, and the inflation tube compressed by a clamp. The torn edges of mucous membrane are compressed beside the bag, and cover the vesical sphincter. The bladder drainage is via the urethral tube, which passes through the bag, and by the suprapubic tube, which, being a part of the inflation tube naturally lies in such a position as not to rest on the bottom of the bladder.

painful procedure. The employment of a hæmostatic bag of the Hagner or Pilcher type, recommends itself chiefly because it is not time consuming, does control the ooze from the prostatic capsule, and by tucking the torn edges of the mucous membrane about the bladder outlet, over the bladder sphincter, so as to be compressed by the inflation of the bag, hæmorrhage from both these sources can be arrested, quickly and completely.

The only time-consuming feature aside from drawing the bag into position, following suprapubic prostatectomy, is the adjustment of the suprapubic drainage tube. To overcome this and facilitate the proper location of the drainage tube, and to provide for greater drainage through the penile tube of the Pilcher bag, I have had the bladder aperture of the penile drainage tube enlarged, and have had cemented to the "inflation tube" a suprapubic drainage tube, so that when the bag is drawn into the prostatic urethra, by withdrawing the penile tube down through the urethra, the suprapubic tube is made to occupy a proper position in the bladder. By employing this device bladder drainage is secured by means of the tube passing through the bag, and out through the urethra, and by a suprapubic tube placed in such a way as not to rest upon the bottom of the bladder.

This device, which we have used for several years, has proved, in our hands, to be the simplest and most satisfactory method of controlling postoperative bleeding following a suprapubic prostatectomy, is the least time consuming in execution, and has supplied the most satisfactory form of bladder drainage.

TECHNIQUE

The technique of employment, briefly stated, is to pass a catheter to the bladder, and after the bladder has been thoroughly irrigated, to distend it with fluid and withdraw the catheter into the penile portion of the urethra. If urine does not escape, because of the nature of the prostatic obstruction, suprapubic cystotomy is carried out. If, however, urine does escape, because the prostatic obstruction is not sufficient to hold all the bladder medium, a urethral clamp, that employed for incontinence,[1] is clamped onto the penis just beyond the end of the catheter (Fig. 1).

[1] Described in Tr. Am. Urol. Ass., N. E. Branch, 1916-17.

Suprapubic cystotomy and the enucleation of the gland is then carried out. The clamp, if used, is then removed and the catheter forced through the bladder and drawn out through the suprapubic wound. A metal cap, fixed to the penile tube of the bag, is fastened to the catheter by passing a small hook into the eye of the catheter (Fig. 2), or if the "cap" is not available the penile tube of the bag is sutured to the end of the catheter. The catheter is withdrawn, bringing the penile tube of the bag through the urethra, and drawing the prostatic bag with the suprapubic drainage tube into position. With the finger at the bladder outlet, the free edges of the mucous membrane are tucked down over the vesical sphincter; the bag inflated with air and the "inflation tube" clamped (Fig. 3). Thus the bleeding from the prostatic capsule, and that from the torn edges of the mucous membrane, is arrested by pressure. It then simply remains to control the divided vessels in the bladder wall by suture; about the suprapubic and "inflation tube," and close the external wound about these tubes and the drain to the prevesical space.

About 24 hours later the air is allowed to escape from the bag, which, however, is left in position. If bleeding becomes active, the bag may be reinflated, and if there is no increased bleeding in the succeeding 24 hours, the device is removed, and suprapubic drainage continued by the introduction of a large de Pezzer catheter through the suprapubic wound.

MODIFICATION OF RUBIN TECHNIQUE FOR TRANSUTERINE INFLATION OF FALLOPIAN TUBES

By ADOLPH JACOBY, M.D., New York
Associate in Gynecology and Chief of Gynecological Clinic, Dr. Bandler's Department, New York Post Graduate Medical School and Hospital

THE Rubin technique for the transuterine inflation of the tubes has proven to be a very valuable procedure for the determination of the part played by the tubes in instances of sterility. By this means the patency or closure of the tubes can be ascertained without recourse to operation. For the purpose of this test the Rubin procedure requires a tank of oxygen or carbon dioxide gas, to which is attached a pressure reducing valve, and a flow volumeter to measure the quantity of gas introduced, a spring manometer for the estimation of the pressure with which the gas flows into the uterus, a Keyes-Ultzman cannula with a few extra holes bored near the distal end, and an ordinary rubber urethral tip slipped over this end and placed about 1.5 inches along the shaft, the necessary rubber tubing for making connections with these various parts, a tenaculum and a bivalve speculum.

The modification in this technique which I have used consists essentially in the substitution of a Janet Frank syringe for the tank of gas with its attached reducing valve and flow volumeter and the injection of air instead of oxygen or carbon dioxide. One may use any other suitable means for the introduction of air, such as a rubber bulb. The method of performing the test is as follows: with the patient in the dorsal position the bivalve speculum is introduced. The cervix and vagina are wiped dry with cotton and painted thoroughly with tincture of iodine. The cannula prepared as above is introduced into the cervix past the internal os. The urethral tip on the cannula pressed against the external os acts as an obturator and prevents the regurgitation of gas. A tenaculum for grasping and steadying the cervix is as a rule unnecessary, for it is usually easy to introduce the cannula without it, doing away with the pain attendant on its use, and slight pressure on the cannula, serves to hold the obturator firmly against the external os. The cannula is now connected by means of rubber tubing and a T tube connection, to a spring manometer on the one arm and a Janet Frank syringe with the plunger drawn out to its fullest extent on the other. Air is gently introduced through the cannula by pressure on the plunger of the syringe. The pressure exerted is recorded on the manometer. A pressure of 220 millimeters mercury is the maximum permitted, and if the air will not flow at that pressure maintained for a little while, the tubes are considered closed. In such cases retests are made one or two weeks later. The usual initial pressure varies from 60 to 120 millimeters mercury with a fall of pressure when the initial resistance is overcome and the air is flowing. It has been found that it is sufficient to introduce from 50 to 75 cubic centimeters of air. There is no immediate reaction. Varying from a few minutes to a half hour after the patient assumes the upright

position, there is a pain felt in the upper part of the abdomen and later in one or both shoulders, more commonly the right. This pain lasts with diminishing intensity for about 2 days, the duration depending upon the amount of air introduced, but at no time seriously inconveniencing the patient. No other reaction occurs.

This procedure has been used in 40 cases to date, with no evidence of any serious result, such as infection. Nor is there any reason to expect it, as the result of the introduction of air, since in every laparotomy air enters the peritoneal cavity with no untoward results. All the instruments used are of course sterilized.

The advantages in this modification of technique are obvious. It eliminates the necessity of having on hand cumbersome tanks of gas with their attachments. There is no possibility of the air being exhausted, as occasionally happens with a tank when a test is in progress. Being more compact the apparatus is readily portable should occasion arise. Furthermore there is no expense and inconvenience in the replacement of tanks. Air is free and always obtainable. The slight increase in the duration of the reaction can hardly be considered as a drawback, since it never amounts to a very great discomfort, and can be regulated by the amount of air introduced. This, as far as I can tell from the literature, is the first use of air for this test.

THE TREATMENT OF POSTOPERATIVE NAUSEA, VOMITING, AND DISTENTION IN CERTAIN ABDOMINAL SECTIONS BY THE USE OF A MODIFIED DUODENAL TUBE

By CONSTANTINE L. A. ODÉN, M.S., M.D., Chicago
Assistant to Dr. A. J. Ochsner, Augustana Hospital

DURING recent years the use of the duodenal tube has become more general for diagnostic, investigative, and therapeutic purposes. Clinicians and research workers give varied reports as to its relative value. The apparently favorable results obtained in the hands of a few, because of its use as a therapeutic agent, has been responsible for the increased interest.

The immediate abatement of nausea and vomiting obtained after gastric lavage following an abdominal section has been noted, and in many clinics its use has become a portion of the regular routine. Frequent repetitions of the procedure are often necessary for the comfort of the patient.

Inhibition of peristalsis following the manipulation of the bowel during an operation may occur with the result that secretions, emptied into the lumen, lie dormant. Observation of the resulting nausea led me to determine the results of emptying the upper intestinal tract by means of a duodenal tube. The abatement of nausea and vomiting in every case was quite striking.

While at Bellevue Hospital, working under the direction of Drs. Warren Coleman and Max Einhorn, a study of the intestinal flora was made at different levels. This was made possible only by means of the use of a special coating for the Einhorn olive which I improvised and reported in the *Journal of the American Medical Association*.[1]

[1] C. L. A. Odén. J. Am. M. Ass., 1921, lxxvii, 1889-1890.

X-ray pictures were taken at various intervals, and proved that it was possible for the tube to pass through the entire intestinal tract. With this knowledge at hand I modified the duodenal tube (Fig. 1), by making numerous perforations, 2.5 centimeters apart, for a distance of 35 centimeters to permit the escape of gas and fluids from the intestinal tract traversed.

Ordinarily, the tube will be well into the duodenum and jejunum if passed 12 hours previously. If, perchance, some obstruction should prevent its ready passage, the surgeon can overcome this difficulty, and aid its downward progress into the duodenum and jejunum by direct manipulation.

Through the courtesy of Drs. A. J. Ochsner and N. M. Percy, of the Augustana Hospital, I have been able to observe the results obtained from its use in various types of intestinal and abdominal cases on their surgical services; the results have been gratifying.

The upper intestinal tract is very susceptible to toxins which are believed to be responsible for the occurrence of an acute dilatation of the stomach and, in some instances, hiccough. The use of the stomach tube gives immediate relief, but as it removes only the gastric and not the intestinal toxins, this relief may not be permanent. As absorption occurring from the small intestine is much more general and rapid than from the stomach, it is reasonable to expect that a con-

tinuous gastro-intestinal lavage would be much more efficacious than simple gastric lavage. By this method elimination of toxins from the whole gastro-intestinal tract is made possible.

If vomiting is a physiological effort of the stomach to rid itself of its contents, a constant mechanical source of escape without the so often severe and painful retching should serve a good purpose and relieve the field of operation of unnecessary strain.

The nurse in charge is instructed to aspirate the contents every half hour for three hours following operation, then every hour or two as is indicated by the comfort of the patient. In many instances, it is better to leave the stop-cock open and allow continuous siphonage, thus establishing a constant source of elimination of gas and fluids.

In case aspiration is not carried out in a proper manner, there results a non-emptying of the contents, and the so often occurring nausea and vomiting becomes apparent. Later, aspiration results in immediate relief of the distressing condition. In several instances, the tube has been left *in situ* from 3 to 7 days with complete relief, but occasionally after its removal nausea occurred.

After each aspiration warm water is instilled through the tube and aspirated with an asepto syringe, and this is continued until the return is clear. The stop-cock can then be left open to allow further drainage and passage of gas.

For illustrative purposes, I cite two from several cases upon whom the tube has been used.

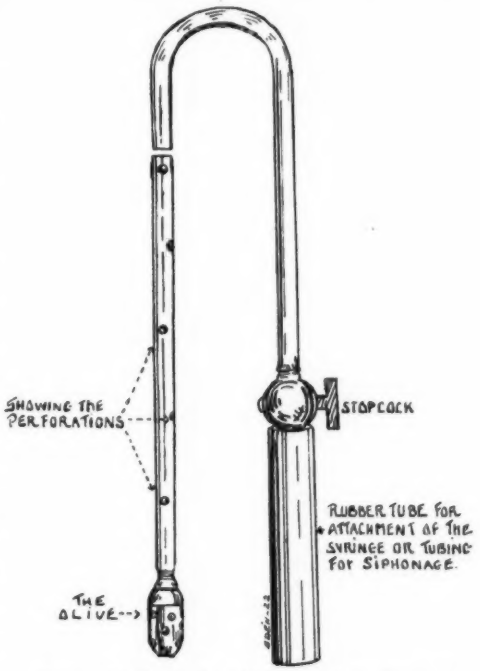


Fig. 1. Modified tube with perforations (in part).

CASE 1. E. L., female; age, 47; saleslady. One week previous a complete hysterectomy had been performed. Exploration revealed a gall bladder filled with stones, also a thickened appendix. Her condition did not warrant the removal of these at this time. The postoperative condition was stormy. She was very nauseated, vomited and was distended. After a few days she improved and one week later a second operation was performed.

The cholecystectomy was difficult and thus prolonged the operation; the appendix was also removed. A modified tube was passed the night previous. At the time of operation, it was found to be well in the duodenum and jejunum as desired. Aspiration was begun while patient was still upon the operating table.

Bile and other fluids were obtained. After the removal to her room, the aspiration was continued at intervals of one-half hour with the result that large quantities of bile and gas were removed, after which warm water was instilled. At no time was there any distention or vomiting. On the second day, the aspiration was delayed, and the patient became nauseated, but this disappeared immediately upon resuming the regular routine. The tube was accidentally pulled out on the third day, but there was no further nausea or vomiting, and the patient made an uneventful recovery.

CASE 2. E. S., female; age, 55; housewife. Three years previous to admission patient had cholecystectomy for cholelithiasis. She felt well for some time, but again became ill with the same symptoms, which were chills followed by sweats, pain in the right upper quadrant radiating to the right shoulder, also slight jaundice and itchy skin. She came for consultation and later treatment. Diagnosis of stones in the common duct was made, and operation advised.

Because of a stormy convalescence due to nausea and vomiting during previous operation, a modified tube was inserted the night before, and at operation was found to be well through the duodenum. The operation consisted in opening the common duct and removing several stones of varied sizes. The opening into the duodenum was nearly obliterated which necessitated the anastomosis of the common duct to the duodenum.

Aspiration was begun while patient was still in the operating room and continued at frequent intervals after removal to her bed. Later the stop-cock was left open and allowed to siphon. Lavage was made at intervals with 5 per cent sodium bicarbonate solution. The tube was left in place for 7 days. There was no vomiting or distention during this time, nor was there any drainage of bile at any time through the abdominal wound. Bile was not allowed to accumulate in the duodenum. She made a good recovery.

SUMMARY

The tube as described and used—

1. Relieves distention,
2. Prevents nausea,
3. Removes toxins,
4. Supplies fluids,
5. Can be used for instillation of therapeutic agents.

CORRESPONDENCE

RHINOPLASTY AND CHEEK, CHIN, AND LIP PLASTICS WITH TUBED, TEMPORAL-PEDICLED FOREHEAD FLAPS

To the Editor: The undersigned authors of the article on "Rhinoplasty" which appeared in the January, 1923, issue of SURGERY, GYNECOLOGY AND OBSTETRICS through simple inadvertence in the attempt to cut down the length of their article, neglected to mention the source of some of the illustrations. These were taken from an article by Dr. Moure which appeared in the *Presse Médicale*, Paris, December, 1921, No. 103, p. 1021. The omission was unintentional and is deeply regretted by the undersigned.

CLARENCE A. MCWILLIAMS, M.D.
HENRY S. DUNNING, M.D.

New York

THE REGULATION OF CONCEPTION

To the Editor:

The Chicago Gynecological Society is desirous of giving proper publicity to its present stand on the subject of the regulation of conception. The following paragraphs are, therefore, submitted for publication:

In accordance with a resolution passed by the Chicago Gynecological Society the undersigned committee sent to all of the members of the Society a questionnaire dealing with various phases of the general subject of regulation of conception. The replies were analyzed and submitted to the Society at its regular business meeting of January 19, and the Society unanimously approved of the following conclusions:

1. It is against public policy that information as to contraceptives should be given to the general public.
2. Information as to the prevention of conception should be given, wherever indicated, to wives and husbands by physicians, either privately or in existing clinics and dispensaries.
3. Special clinics for the dissemination of this information are neither necessary, nor desirable, nor should nursing organizations be utilized to give out such instructions.
4. Risk to the mother, based on ill health, whether due directly to existing disease, or to the drain of too frequent childbirth under unfavorable home conditions is the essential indication for instruction in prevention of conception.
5. All mechanical devices used by the wife as well as strong chemical douches are discountenanced.

Respectfully submitted,

RUDOLPH W. HOLMES.
JOSEPH L. BAER.
N. SPROAT HEANEY.

EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

FRANKLIN H. MARTIN, M.D. ..... Managing Editor
ALLEN B. KANAVEL, M.D. ..... Associate Editor

APRIL, 1923

BONE METASTASIS

IN cancer, bone metastasis is much more common than was hitherto believed. Schmorl of Dresden found that no less than 34 per cent of all cases of cancer coming to autopsy exhibited metastasis in bone. He published his observations in 1908. In the cases investigated by Schmorl post mortem, the secondary bone deposits were not always discovered until the medulla of the bones was opened up or after microscopic examination had been made. He concludes that the medulla of bone provides material which is particularly suitable for the growth of cancer cells. He makes the further interesting observation that secondary cancer may be found in the ossifying cartilages of the larynx and in the heterogeneous bone formation in aorta, glands, and in the tracheal and bronchial cartilages. Cancer cells, according to this authority, produce an incentive to the growth of bone, and he suggests a direct relationship between the secondary cancer deposit and heterogeneous bone formation.

Experience shows that metastatic tumors in bone may be present without being suspected by either the patient or the medical attendant: in many instances their existence has only been discovered accidentally. The complaint of pain in various parts of the skeleton, particularly in the spine, in patients suffering from cancer, should arouse suspicion: an investigation by the X-ray may demonstrate the presence of secondary growth in such cases. On the other hand metastases may lead to deformity in the spine or fracture of a long bone. In some instances extensive bone destruction may occur as, for example, in one instance where fully one-fourth of the tibia near its middle was completely destroyed by cancer growth secondary to uterine carcinoma. The cranial diploe is not an unusual site for such metastatic growths and these deposits in the diploe may be multiple. In fact the possibility of multiple deposits in all parts of the skeleton is a very remarkable circumstance. The writer has one case of breast cancer with X-ray evidence of secondary deposit in nearly every long bone of the body and in the cranium.

It would appear that the metastatic growth in bone is often latent and may remain of limited size for months or even years. The growth is for long periods confined within the bone, and there is little tendency to an invasion of the soft parts. In time, however, the soft parts may become invaded, and this is usually accompanied by increased rapidity of growth. There is evidence too that their growth is influenced by X-ray and possibly therefore by radium. One has found that pain due to such secondary deposits may be relieved very greatly by X-ray treatment. When fracture of a long bone occurs at the seat of a metastatic growth, union may occur after

suitable splinting: new bone formation occurs and the continuity of the bone is restored. At times, however, the extent of bone destruction renders union impossible.

Rokitansky in 1846 describes conditions which he believes to be "primary" cancer in bone: his error was explained either by assuming that he confused cancer with sarcoma or by failing to locate the primary growth elsewhere in the body of which the tumor in the bone was a secondary manifestation. He speaks also of "secondary cancer" in bone, but here too the reference he makes is not to metastatic formation but to direct extension, of the primary growth, into a neighboring bone. Thus the instances he gives are of invasion of the ribs and sternum in mammary cancer: the invasion of the skull from a primary growth situated in the dura mater of the brain and the occasional invasion of the bones of the pelvis from cancer of the uterus.

Possibly the first recorded case in which secondary cancer in bone was recognized in its true relationship to the primary growth was that recorded by Sir Henry Thompson in 1854.[1] This was a case of cancer of the prostate with secondary deposit in the lumbar spine. It is of interest to note that "Mr. Henry Thompson" was 31 years of age at the time, and the autopsy report, which is published in detail, and dated 21st of March, 1851, was signed by "Mr. Johnathan Hutchison" who was 23 years of age. Thus these two young men, who subsequently became famous in surgery, had been working together and thus early in their career had established an important fact regarding the manifestations of cancer.

Von Recklinghausen made a careful study of cancer growth in bone in 1891. Since that period the true significance of cancer development in bone has been better understood. Bone, as we have stated, may be invaded by direct spread from the primary growth, e.g. involvement of the ribs and sternum from breast cancer. According to Sampson Handley the secondary deposits in more distant bones (humerus, spine, etc.) may be caused by direct extension through lymphatic channels: one of his arguments in this connection is the immunity of the bones below the elbow and below the knee: such cases being too distant for lymphatic connection. On the other hand he traces lymphatics to the deltoid insertion of the humerus, and to the great trochanter of the femur as the most likely points of entrance for these bones. Schmorl and many others consider the pathway to be by the blood stream.

Secondary cancer deposits in different parts of the skeleton have frequently been encountered in cancer of the breast, prostate, uterus, etc., but in addition we have examples of other metastatic growths in bone. Of these perhaps the most frequent is hypernephroma of which many instances have been recorded. These have been most commonly found in the long bones but have also been described in the cranium and the sternum.

A. PRIMROSE.

[1] Tr. Path. Soc., 1854, v, 224.

A STANDARDIZED OPERATION FOR THE EXTRACTION OF CATARACT

THE statement is frequently made that when many different operations are devised, all having the same purpose, none of them is quite satisfactory. The truth of this statement cannot be denied but its application must be qualified if such operations are to be done in cases that present variations in conditions to be met. When a surgeon has once mastered the technique of one method of cataract extraction so that his

results are fairly uniform and satisfactory, is he justified in attempting to extract a cataract by any other method? That has been a puzzling question to most ophthalmic surgeons and has led to considerable discussion by exponents of a uniform method of operation. Are the end-results, when judged by a given standard, enough better to justify one in doing all cataracts by that one method?

Just when it can be said that one has mastered the technique of an operation is rather difficult to say. Yet almost every operator has his favorite method. Whether based upon his teaching, his experience, or upon theory, this operation will be the operation of choice and applied so far as can be in every case. It is quite generally conceded that the factors giving rise to different methods of extraction are the age of the patient, the type of cataract, the maturity of the cataract, and miscellaneous factors such as the general physical condition of the patient, restlessness, previous eye disease, and the usefulness of the second eye.

The importance of all of these factors is brought out in any extended discussion of cataract operations, and has widely influenced the practice of certain methods of preparation of the patient for operation, probably with the thought that it is easier to prepare a patient for a certain method of operation than to change the method of operation to suit the particular case presented. Comparative series of cases operated upon by different methods give a false index of the value of any operation at the hands of any operator, and have no logical basis unless it becomes imperative that some one method shall be adopted for all cases.

There is no uniformity in the types of cataract any surgeon will have to operate upon. The circumstances under which the operations are to be done cannot be made uniform, much less ideal. The limits of safety beyond which one must not go are determined by factors not entirely under the control of the operator and that method must be used and that risk taken which will be compatible with the best results. Every surgeon who attempts the extraction of cataract should be familiar with the technique of a number of operations and have at hand the necessary equipment to do any one of them. The method of operation should be determined by the conditions surrounding the cataract and not by the inclination of the operator. No one is justified in operating upon all types of cataracts under all circumstances by any one method.

W. L. Benedict.

MASTER SURGEONS OF AMERICA

CHARLES THEODORE PARKES

DURING the years immediately following the beginning of antiseptic surgery, a group of young surgeons appeared in America with quite unusual qualifications—men with boundless energy, unflinching perseverence, absolute honesty of purpose, clearness of judgment, exalted enthusiasm, and an intense desire to advance to the highest surgical excellence.

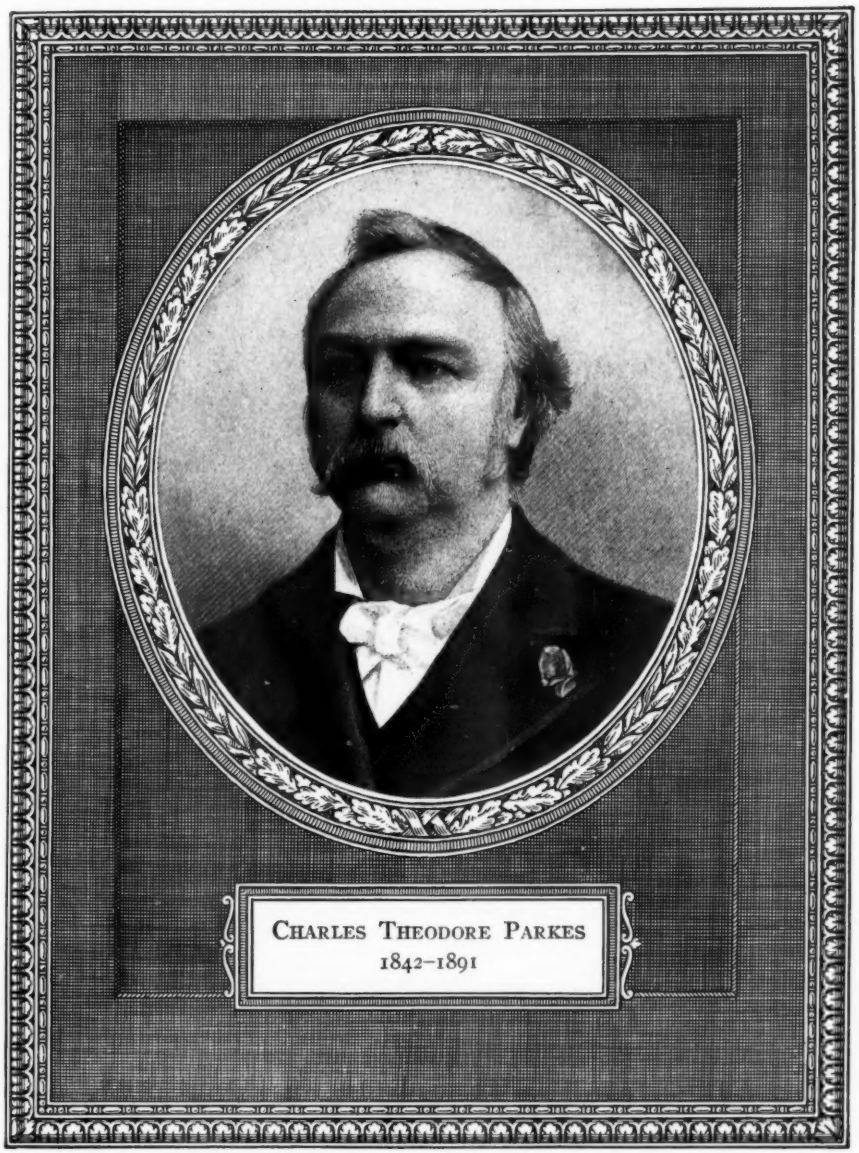
Many of these surgeons were splendid anatomists and excellent practitioners of general medicine, but had not enjoyed the benefits of a university education. In many cases, however, the student had engaged in teaching public school, or had broadened his mind by contact with men of ability during service in the army in our Civil War.

These men were hardy and clear-headed, unafraid of hardships or hard work. What they lacked in scientific training they made up in character and personality, and in those individual characteristics which enable men to accomplish unusual ends, and to leave a lasting impression upon their fellow workers and upon their community.

The most brilliant and withal the most lovable and attractive, and in his personality the most distinguished of all the surgeons of this group, was Dr. Charles T. Parkes of Chicago. Physically large and powerful, he was able to perform an unbelievable amount of work. Mentally a giant, he was able to grasp the surgical problems of his day with a clearness and precision which have rarely been equalled among the many great surgeons whose work I have been privileged to observe. His success depended primarily upon natural ability, personality, industry, and perseverence, but his environment and education aided greatly in bringing about such unusual results.

For generations his father's people were iron-workers in Stratfordshire, England. His mother's family had migrated to England from Brittany. His parents came to America in the late twenties of the past century. His father engaged in the production of iron, becoming half owner of one of the largest iron works in the west, located at St. Louis, Missouri.

During these years young Parkes enjoyed educational advantages in private and public schools, interrupted attendance at high school and 2 years at Ann Arbor University. The panic in the late fifties swept away his father's fortune,



CHARLES THEODORE PARKES
1842–1891

and this and the beginning of the Civil War interrupted his education. He taught school before joining the Union army at the age of twenty. He entered service as an enlisted man, and during his 3 years' service he became the most skillful drillmaster in the 117th Illinois Volunteer Infantry. While holding a captain's commission, he was given an independent command at Island No. 10 in the Mississippi River. He received mention in the War Department Records for an act of heroism.

Immediately following his discharge from the army, he entered Rush Medical College becoming the special student of the professor of anatomy. No doubt his army experience gave Parkes a willingness and an ability to do the enormous amount of work involved in carrying his studies, while doing the work of assistant to the chair of anatomy and acting as prosector.

Shortly after his graduation in 1868, he was made demonstrator of anatomy, which position he held until 1875, when he was elected to the chair of anatomy in Rush Medical College. This position he filled with distinction until the year 1887, when upon the death of Professor Moses Gunn, he was elected to occupy the chair of principles and practice of surgery and clinical surgery in his Alma Mater.

Shortly after his graduation, he received the appointment of surgeon to the North Chicago Rolling Mills, attending surgeon to Cook County Hospital, attending surgeon and later surgeon-in-chief of St. Joseph's and Augustana Hospitals, and attending surgeon to the Presbyterian Hospital. Dr. Parkes studied in London, Edinburgh, and Paris during the year 1878, and visited the surgical clinics of Germany during the summer of 1888 and 1890.

Dr. Parkes possessed great physical and moral courage. A story of his army life shows this side of his character. During an engagement, while within easy range of the enemy, it became necessary to signal to a re-enforcing division. In order to be seen, he mounted a fence in view of the enemy and gave his signal with a flag. Immediately a volley aimed by the enemy shattered the fence, fortunately leaving him unharmed on the ground. The flag, with its shattered staff, is in the State Museum at Springfield.

The following story is told to illustrate his enormous physical strength. In demonstrating anatomy, he was constantly annoyed by a large fellow, who persisted in crowding in ahead of the other students. When the patience of Dr. Parkes was exhausted, he picked the man up bodily, passed him over his head, and dropped him down behind him, to the great pleasure of the class.

Parkes received much inspiration from the remarkable men who composed the faculty of Rush Medical College from 1865 to 1890. Every man was a leader of men. They may not have ranked so high, in a cultural sense, as some professors in eastern medical schools, but they were enthusiastic teachers, who made teaching their first responsibility. Among these men were Moses Gunn,

J. Adams Allen, William Byford, Robert L. Rae, Henry Lyman, Edward Holmes, Delaskie Miller, Joseph Ross, J. W. Freer, and later Norman Bridge, James Nevius Hyde, and the best teacher and most charming gentleman of all, Walter Haines.

With these remarkable men he worked with wonderful enthusiasm, first as student and assistant, and later as the most distinguished colleague. His lectures and clinics were perfectly prepared, without regard to what it cost in fatigue or sacrifice, in consultation or practice. His college work was always his first responsibility. It was this which cost him his life. He was taken with influenza, but would not remain at home on his clinic day, although he was strongly urged to do this. During this clinic he had his fatal chill.

Parkes was one of the first surgeons west of Boston, New York, and Philadelphia, who performed many abdominal operations during the years 1880 to 1890. His diagnostic ability was so great that he acquired a national reputation which brought difficult cases to his clinic from many states. His absolute mastery of anatomy, with his years of practice in the dissecting room, gave him a command of surgical technique which I have rarely seen equalled and never excelled. His familiarity with every tissue enabled him to complete an extensive operation in an incredibly short time with an amount of traumatism so slight, when compared with that produced by other surgeons, that his patients came out of the anæsthetic with enormously less shock than similar patients operated on by other surgeons. They consumed much less ether, were exposed a shorter time to the possibility of infecton, and their wounds were in a much better condition for primary union because the tissues had not been unduly traumatized. He emphasized the importance of tying sutures so as to secure exact co-aptation, but never strangulation of tissues. His wounds healed regularly by primary union quite to the extent that such results are obtained in the very best clinics today.

With the exception of operations upon the eye, nose, and throat, he covered the entire field of surgery, excelling in general, abdominal, and gynecological surgery. His operations on bones and joints, and those for club feet, wry neck, cleft palate, hare-lip, and other deformities were quite remarkable and original. Here again his complete anatomical knowledge gave him an unusual advantage. He was, I believe, the first surgeon in this country to remove a stone from the pelvis of a kidney, and from the common bile duct, and one of the first to perform many gall-stone operations.

Parkes was one of the first surgeons in this country engaged in extensive original research and animal experimentation. His address "The Treatment of Gunshot Wounds of the Small Intestine as a Result of a Series of Experiments on Forty Dogs" presented before the American Medical Association in 1884, is a splendid piece of work, and his conclusions are still surgically correct. This was the most notable one of his many excellent papers. Of these, one on chole-

cystostomy, and one on choledochotomy, which operations he performed in 1885, amputation of arm, together with clavicle and scapula for sarcoma in 1889 with report of two cases, fifty successive cases of ovariotomy for removal of tumors, 1888, received international attention.

Parkes entered the field of surgery before Billroth, Volkmann, and Fenger had introduced pathologial training in the field of preparation for entrance into surgical practice; in fact before American medical colleges were equipped with pathological laboratories, but his surgical judgment was so excellent and his observations so acute and so extensive that this lack of training in a subject, upon which we now lay so much stress, did not seriously impair his surgical efficiency.

As a teacher, Parkes was the ideal of the medical student and the practitioner alike, because he gave them in a clear, concise way, exactly what they needed in their practice, not loaded down with a lot of irrelevant material. This is shown with great clearness in his clinical lectures which were taken down stenographically during the last year of his life, and published after his death. I have recently read these lectures again, and was amazed to see how much of the best of our present surgical practice they contained. Practically all of the younger surgeons of the middle and western states attended his enormous clinics at Rush Medical College, and followed his teaching in their practice. Thus he became the teacher of hundreds of progressive young surgeons.

Parkes died March 28, 1891, at the age of forty-eight, at the height of his success. He kept thoroughly abreast with all advancement in surgery of his day, and received recognition from all sides. Few men have had the personality, the industry, and the ability to accomplish so much as did Dr. Parkes in the few years of his too short life.

A. J. Ochsner.

TRANSACTIONS OF SOCIETIES

CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD DECEMBER 15, 1922, DR. HENRY F. LEWIS, PRESIDING

POSTMATURE PREGNANCY

DR. W. A. NEWMAN DORLAND: I would like to say a few words regarding a case presenting some unusual features.

The patient is a Jewish girl, 20 years of age, born in Turkestan, Asia, who gives a history of irregular menstruation. Puberty occurred at 13, but she missed one or two periods at frequent intervals. She menstruated last on December 12, 1921. In March, 1922, she complained of nausea and vomiting. About June 1, she felt fetal movements, and assuming that to be the middle of pregnancy she should have been confined about the end of October. Last week she visited the Lying-In Hospital and was told that she should have a cæsarean section done at once, to which she objected, and her physician brought her to my office. On examination I found the abdomen greatly distended and drum-like; the fetal heart 140, and strong fetal movements both to be seen and felt. The baby was lying on the right side in the second position, and the os was partially dilated. The head was very large. From the X-ray examination made at the other hospital it was thought that the baby probably had hydrocephalus, but the X-ray pictures made for me by Dr. Hubeny do not show this. I advised the patient to wait for another week, and then I would do a cæsarean section, which was agreed upon. She fell into labor at 1 o'clock yesterday morning and at 4 o'clock I performed a cæsarean section, delivering a living baby, weighing 10 pounds. Today I took the fetal measurements which showed the circumference of the head to be 36 centimeters, 14½ inches; biparietal diameter, 11½ centimeters; bitemporal 10½ centimeters; trachelo-pregmatic 14½ centimeters; occipitomental, 22 centimeters instead of 13½; frontomental, 9½; length of the fetus 20½ inches or over 50 centimeters; weight of the placenta 32½ ounces—2 pounds ½ ounce; giving her a large abdominal content and proving conclusively that she would not have been able to deliver herself. The X-ray pictures will show a baby, taken left and right, with the head lightly wedged in the false pelvis.

DISCUSSION

DR. RUDOLPH W. HOLMES: For many years I have consistently maintained that authenticated instances of prolongation of pregnancy were so infrequent that few physicians have seen such, that the reiterated reports of postmature pregnancies were figments of the imagination, based upon inexact data. We cannot doubt that true prolongation of pregnancy is possible. In substantiation of this I present the following case, the first, conclusive to my mind, in my experience. A woman menstruated December 12, 1921. January 20, 1922, she came to me. She had had nausea since January 11. The uterus was found not enlarged, but presented a suspicious softening. She felt life, April 17, i.e., 125 days after her last menstruation. Accordingly, she should have expected her baby about September 19. The baby was born October 28, 39 days after the expected and calculated time. The baby weighed 8 pounds, 11 ounces.

DR. CHARLES B. REED: I am glad to notice that some of the recalcitrant members are at last beginning to recognize the postmature child. The interesting thing about this subject is that if we measured the babies *in utero* oftener we would see more cases.

In Dr. Dorland's case the size of the head is out of proportion to the length of the baby. With a 50 centimeter baby we get a smaller head than that, and with a head of the size he reports, a much longer baby. The length of the child ordinarily corresponds to the size of the head which in this case is interesting as an exception. We have seen babies that weighted 10½ pounds that were 57 centimeters long, and this is not far from the proportion we would expect to get in a postmature baby.

Whatever the time spent by the babe *in utero* if it reaches so great a size it is postmature almost invariably. The men who do not see postmature babies are like the men who do not get perineal lacerations. They either do not look or do not know what to look for.

DR. DORLAND (closing): I noticed the disproportion between the length of the baby and the size of the head to which Dr. Reed referred, but I think it may be possibly explained in this way: the father was a small Jew, shorter than myself, who had a very large head. The mother was a woman a little under size but otherwise well built. The measurements of the head were carefully taken, and I know they are correct.

DR. LEWIS: What about the amniotic fluid?

DR. DORLAND: There was not an excessive amount of it.

UTERUS SEPTUS BICOLLIS

DR. CAREY CULBERTSON: The patient from whom this second specimen was taken is a young woman who entered the hospital complaining of pain in the lower abdomen, excessive uterine bleeding, leucorrhœa and such other symptoms as are classic in cases of general pelvic peritonitis based upon salpingitis. She had been well prior to 3 months ago save for an abortion, in the early weeks of pregnancy, 1 year ago, though from the history obtained there is some doubt as to the authenticity of the pregnancy. The first thing that attracted attention at the time of examination was a septum dividing the vagina mesially and longitudinally from the hymen to the vault and the presence of a cervix on either side of this septum. The uterus was upright, slightly enlarged, with its mobility reduced and its appendages prolapsed, thickened, tender, and fixed.

As the specimen shows, the uterus is a septate one with two cervices. The cavities are each 8.5 centimeters deep, the mucosa of the left one being not grossly thickened while that of the right is definitely hyperplastic. In this connection it is interesting to note that at the time of operation there was a blood discharge from the left and a profuse leucorrhœa from the right side. The uterine wall is .5 centimeters in thickness while the septum is fully 1 centimeter through; in other words the septum is rather a double wall than a mere partition. This is the fourth septate uterus that I have seen in three and a half years and in all of them the septa has been like the one here demonstrated. An operation has been described for the resection of the septum and the conversion of the two uteri into one by the approximation of the remaining two lateral portions. I have attempted such a procedure in but one of my cases. While feasible, the operation is not fully satisfactory because the septum is so thick that a very small uterus, indeed, is created. I should not attempt this operation in a uterus where the cervix is double, fearing resultant cicatricial stricture in the cervical canal. The obstetrical advantage of such an operation is not evident. It is well known that these maldeveloped uteri do not stand pregnancy well, and I fail to see in what way resection of the septum would assist such a uterus in enduring the strain of gestation. The band of tissue hanging from the cervix represents the vaginal septum which was removed with the uterus. The tubes are thickened, closed, and clubbed, each 10 centimeters in length, showing the changes characteristic of chronic purulent salpingitis.

PURPURA HÆMORRHAGICA IN GESTATION

DR. GEORGE CLARK MOSHER, Kansas City, Missouri (by invitation) read a paper entitled "Purpura Hæmorrhagica in Gestation." (See p. 502)

DISCUSSION

DR. JOSEPH L. BAER: It has been a great pleasure to listen to Dr. Mosher on this rather unique subject. I want him to tell us, if he can, something more about the relation between these purpuras hæmorrhagica in pregnancy and the purpuras that I am sure many of us have seen occurring not infrequently in relation to the menstrual cycle. In the non-pregnant I have seen perhaps half a dozen such cases, one of which I have vividly in mind, which began in the second pregnancy, with a rather profuse hæmorrhage into the calf muscle in the latter part of the second pregnancy. After delivery she has continued at almost monthly intervals to present ecchymoses varying from the size of a dime to half the palm of the hand, quite painful, and just preceding the menstrual cycle. Associated with these spots there has been a diarrhœa, with intestinal peristalsis so active as to be quite painful. There has been no temperature elevation, and no recognizable alterations in the blood picture.

Other cases I recall presented less striking phenomena, being limited chiefly to the appearance of a few ecchymotic spots usually on the lower extremities, and again in connection with the menses. In none of these cases was there any pelvic pathology.

DR. CHARLES B. REED: I have been much interested in Dr. Mosher's paper, particularly from the standpoint of etiology. Dr. Mosher wisely did not go into it, but there are certain people who rush into it where they have no business. Hitherto in the literature all discussion of the etiology has been quite divided as to whether bacteria, toxins, chemical changes or changes in metabolism only are to be blamed. It appears to me, the condition must be due to a change in metabolism of a toxic character for certain reasons. Primarily, some of the cases occur so suddenly, that bacteria cannot be considered. Thus in the cases reported by Bobriski, we find one of a girl of 12 years terrorized by an attempted rape and a boy of 10 terrorized by a fire. In both cases the purpura appeared within 12 hours and logically this would exclude the possibility of a bacterial origin.

We are told by physiologists that certain changes are necessary for the production of blood clots. We have, for instance, thrombokinase arising from certain cellular elements of the tissues. This joins with calcium to produce thrombin and the thrombin unites with fibrinogen to form fibrin. This is a complicated process, producing ultimately a clot. It is necessarily a chemical process brought about finally by changes in the body and not really by bacteria, although we know that toxins, like snake venom and leech extract will produce antithrombin. We find the injection of trypsin, pepsin, and peptone, and other products will, at any rate, inhibit blood clots. If this is the case, it seems very probable that the etiology of this condition will be found along the line of newly-formed elements as in an antithrombin. This is entirely theoretical, but it seems to me the condition is borne out by the fact that nearly all these cases occur in people who are reduced by disease, by the occurrence of sudden

shock or fright or in the presence of pregnancy, and a chemical or metabolic condition is certainly most plausible.

DR. J. P. GREENHILL: As the essayist has pointed out, not many cases of purpura hæmorrhagica, occurring during pregnancy, have been reported in the literature. On this account, I should like to report briefly two cases of which I have cognizance.

The first is a patient, 20 years old, who is now under observation at one of the dispensaries connected with the Chicago Lying-In Hospital. She is now in the fifth month of her second pregnancy. During the first pregnancy, which terminated 2 years ago, she had the simple type of purpura hæmorrhagica, which manifested itself at the beginning of the pregnancy and involved chiefly the mucous membrane of the nose and gums. However, there were petechiæ and ecchymoses on the extremities, the chest and abdomen. There were no symptoms other than these hæmorrhages. The patient went to term, delivered a normal baby spontaneously, and had no undue bleeding after the delivery. The purpura disappeared very soon after the child was born and did not return until the beginning of the present gestation. The most troublesome hæmorrhages are from the nose and gums. However, hæmorrhages on the extremities and trunk have readily occurred after very slight trauma, and in some instances without injury. The compression of the cuff of the blood pressure apparatus produces ecchymoses. Were it not for the occasional severe attacks of epistaxis and gingival bleeding, the patient would have no complaints. She is moderately anæmic; the hæmoglobin is 60 per cent; the white blood cells number 7,400, and the differential count is normal. The bleeding time is 3 minutes, and the coagulation time is 2 minutes. The stained blood smear shows no abnormalities in the red blood cells or blood platelets.

On physical examination the only unusual findings are an enlarged, hard spleen and a very tender gall bladder. The Wassermann test is negative. No blood has been seen in the urine or stools.

During the last few weeks, upon the advice of Dr. Daly, who has been looking after the medical supervision of the patient, the latter has been taking calcium lactate in 10 grain doses, three times a day. There has been a definite improvement in the general health and a reduction in the number of hæmorrhages.

The second patient was one whom Dr. Rubovitz sent to the Chicago Lying-in Hospital last March. She was a primipara, aged 18½, and was in her seventh month of pregnancy. Before admission she had had three severe attacks of epistaxis. On admission to the hospital she showed petechiæ in the conjunctiva, on the eyelids, and on the lower extremities. There was a systolic murmur at the apex of the heart, and this was transmitted upward and outward. Both the liver and spleen were definitely enlarged. The red blood cells numbered 3,100,000; the hæmoglobin was 35 per cent, and there were 30,000 white blood cells. The differential count showed 80 per cent large mononuclears, 8 per cent small mononuclears, and 12 per cent neutrophiles. There were no abnormalities in the red cells. In this patient, therefore, the etiology of the purpura was an acute lymphatic leucæmia. A transfusion was performed, using 500 cubic centimeters of blood from a pregnant woman, but the patient rapidly grew worse and died. Permission for an autopsy could not be obtained. Of interest was the fact that at the undertaker's establishment, a portion of the fetus was found protuding from the vagina. The fetus was extracted and seemed to be apparently normal. It is conjectural whether the abdominal pains of which the patient complained during and after the transfusion were labor pains, or whether the fetus was expelled postmortem.

DR. MOSHER, Kansas City, Missouri (closing): I appreciate very much the courtesy the gentlemen have shown in the discussion of my paper. I feel it is only by discussion that we can clear up the etiology of purpura hæmorrhagica.

With reference to the question as to the tendency to bleed there is such a condition in purpura undoubtedly based on fact. John Phillips has shown in a number of cases in women who had a tendency to purpura or erythema nodosum a likelihood of superficial bleeding, either petechiæ or ecchymoses, more excessive at the time of menstruation, and there must be some relation between this type of bleeding and the purpura in pregnancy.

The authorities agree with Dr. Reed when he says that the etiology is not determined, but we believe that it is more or less a metabolic condition. So far as the laboratory examinations that have been made demonstrate any relation with infection it is simply coincident. We are not at present able to show any bacterial involvement. The uterus has been removed postmortem and there has been found no evidence of sepsis; and nothing to indicate a chemical change.

The so-called scorbutic purpura suggests that there is in a certain class of women a dyscrasia, a condition of reduced resistance, which predisposes them to purpura, and a woman thus reduced is more likely to become the victim of purpura than the average. The fact that transfusion has been followed by very satisfactory results in the cases where it has been given should prompt one who may come in contact with a case of purpura hæmorrhagica to resort to this method of treatment, at the first opportunity rather than to experiment with other therapeutic measures which are usually futile, the patient meantime becoming subject to increased danger which it may be later on impossible to relieve.

BOOK REVIEWS

A CRITIQUE OF NEW BOOKS ON SURGERY

IN this review we call attention to a group of books the themes of which are widely diverse while yet they look upon the science of medicine from porches of considerable magnitude.

The monograph by Father Burke entitled *Acute Cases in Moral Medicine*[1] is a valuable document. In convenient form is printed for the first time the official attitude of the Catholic Church toward such unhappy emergencies as abortion, embryotomy, premature labor and ectopic gestation. The decisions in these cases have been handed down at various times from 1883 to 1905. It is, therefore, authoritatively determined that wherever a living ovum would be destroyed, all interference is forbidden. This means that no devout adherent of the Church, no matter what his scientific training, can do an abortion in behalf of the mother even though such a mother is attainted by incurable disease like cancer, tuberculosis, or pernicious vomiting of pregnancy. He may not do embryotomy in behalf of the mother without violating ecclesiastical law unless the child be dead. He may not remove an ectopic gestation unless rupture has occurred. The various methods of administering baptismal rites in emergencies is also adequately described. C. B. REED.

IT is not a far cry from this work to the book by Dr. W. W. Keen entitled, *I Believe in God and in Evolution*.[2] The superficial upheavals of the social structure which are brought about by charlatans who try to gain kudos through attacks upon the body of our accepted scientific truths serve at least the purpose of making us examine again the evidence upon which those truths are founded.

Dr. Keen has made this re-examination with concision and concludes, in the words of his dedication which we gladly accept, "To all sincere seekers after truth; who revere the Bible as the word of God; who revere Nature as the work of God; who believe that rightly interpreted they must surely agree."

When the Scriptures and Science are compared intelligently and without prejudice their co-ordination is inevitable, as Dr. Keen has so graphically and so logically attested. C. B. REED.

THE facile and versatile pen of Dr. Keen is responsible also for a second mention in this more or less medical group. His *Papers and Addresses*[3] uttered on various public occasions in the past are now collected and issued in one volume. They cover necessarily the most diverse topics. To the members of the American College of Surgeons the description of the forms of graduation in Old World colleges and institutions will have a strong ceremonial interest while the essay on the "Medical School and the Public" will appeal to the lay as well as to the professional reader.

"Before and after Lister" reviews for the surgeon and medical historian a critical phase of our progress but from every standpoint the two papers on vivisection are most important.

In these days of vaccination and serum therapy small pox is almost unknown, typhoid is easily controlled and diphtheria no longer a menace, and yet these diseases and tetanus and many others would now be as prevalent and as deadly as of old if the antivivisectionists had succeeded, as they hoped, in reducing animal experimentation to the state of utter extinction in which it existed in the Egypt of the Pharaohs and the Europe of the Dark Ages. Dr. Keen's vindication of its high value and utility to the commonwealth is logical and complete. C. B. REED.

FROM the moral phase of obstetric interference, through the gradual blending and interimpregnation of religion and science, we come to the *History of Medicine* by Walter Libby.[4] In this book we have the story of the growth of medical science from the faint vestiges of the past to the uberous and efflorescent present; from the priest physicians of Egypt and Babylon, when science and religion were synonymous terms, down to the time when bacteriology divorced the theorist and empiricist entirely from medical science.

With his luminous exposition of medical growth the author weaves in a generous amount of biographical material concerning the great discoverers who have made that growth possible. C. B. REED.

WE next come by a perfectly natural process to the work of a man who had no knowledge of evolution, indeed, but hesitated not to discuss religion and medicine, art and science, in every phase in which they affect humanity. In fact the chief subject of Montaigne's meditations and writings is the philosophy of life.

[1] ACUTE CASES IN MORAL MEDICINE. By the Rev. Edward F. Burke, M.A., Ph.D. New York: The Macmillan Co., 1922.

[2] I BELIEVE IN GOD AND IN EVOLUTION. By W. W. Keen, M.D. Philadelphia and London: J. B. Lippincott Co., 1922.

[3] SELECTED PAPERS AND ADDRESSES. By W. W. Keen, M.D., LL.D. Philadelphia: George W. Jacobs & Co., 1923.

[4] THE HISTORY OF MEDICINE IN ITS SALIENT FEATURES. By Walter Libby, M.A., Ph.D. Boston and New York: Houghton Mifflin Co., 1922.

In Taylor's volume[1] on *Montaigne and Medicine* we have abstracted for us, that portion of the great essayist's reflections which concern personal health and the art of medicine directly.

Probably a dozen similar books could be separated out in the same way on the diverse topics which Montaigne has thought upon and illuminated.

A large library of critics and commentators has grown up around the essays and other material which this eminent egotist and subjective expositor has left to us. It is doubtless true, as Hazlett says, in illustrating the protean interests of the philosopher, that the Montaigne of Bayle is a gentlemanly skeptic, the Montaigne of the Voltaireans is a scoffer, the Montaigne of Abbé Labordie is a Capuchin Friar and the Montaigne of Emerson is Mr. Emerson himself. Mr. Taylor, however, has been extremely conscientious in eliminating his own personality and presents us, in one handsome volume, with a lucid and consecutive anthology of Montaigne's views on contemporaneous, and therefore 16th century, medicine. Altogether it is a gracious work and graciously has Taylor accomplished it.

C. B. Reed.

THIS monograph[2] is a practical treatise dealing with the requisites of amputation stumps so that they can best be fitted with artificial limbs; with procedures for improving the utility of stumps; with explicit directions how to measure stumps for artificial limbs and with a complete discussion of the preparation and manufacture of temporary and permanent artificial limbs of various kinds for the upper and lower extremities.

The author does not intend the book to be a complete and encyclopedic work on the subject, such as was published in Germany in 1920 entitled "Ersatzglider und Arbeitshilfen," etc., compiled by 30 authors, but presents it as a record of the conclusions reached as the result of 6 years' personal experience in the treatment of amputation stumps at the Royal National Orthopedic and in various Red Cross hospitals and in the prescription and supervision of prostheses at Queen Mary's Convalescent Auxiliary Hospital at Roehampton. During this time the author had some 25,000 cases under his personal care. While as an adviser on artificial limbs to the Minister of Pensions he has had opportunities of inspecting the various prostheses submitted for approval. The author has tried to avoid making the work a mere compilation of limb-makers' cataloges but has deemed it important to publish the illustrations of the most useful prostheses supplied by various limb-makers, limiting the description to British practice with only a few references to methods used in other countries.

The author's experience and opportunities during the Great War qualify him as one of the leading authorities on the subject, and he has been permitted to publish the drawings and diagrams and other material belonging to the Ministry of Pensions and he presents this valuable data in his monograph. This consists of the war standardization of artificial limbs including specifications for various types in detail. A separate chapter at the end of the work gives full directions for making certalmid sockets. "Certalmid" is the name given to a material made of certus glue, muslin, and celluloid and is a combination, the result of experiments made in the Experimental Workshop of the Munitions Inventions Department of the Ministry of Munitions. Tests have shown that certalmid sockets weigh only half as much as those of the same strength made of willow wood and covered with rawhide.

The work is concise, clearly stated and excellently illustrated. It contains a wealth of most important and strictly up-to-date information in regard to artificial limbs. It should be in the hands of all those who have to perform amputations and all those who are responsible for supplying these patients with suitable artificial limbs.

David C. Straus.

"THE object of this work[3] is to afford theopportunity of acquiring rapidly a practical knowledge of 'regional anæsthesia' and to teach the reader how to use the method successfully." This has been accomplished. The work is a result of a very thorough knowledge of the literature on the subject and a personal experience with many thousand cases. The book is comprehensive, giving details for operations in all parts of the body. Chapter IV discusses in great detail the blocking of spinal nerves. This is especially valuable since it is particularly in this field that Labat has done the most valuable work, both research and clinical. Paravertebral, cervical block, brachial plexus block, dorsal block, lumbar block and other types are discussed. In Chapter IX one is especially interested in his discussion of splanchnic analgesia both at the anterior and the posterior roots, including both Koppis' and Labat's technique.

The material is presented very clearly. Each technical description is preceded by a practical presentation of the anatomy of the region, with special reference to nerve distribution. The illustrations in conjunction with these anatomical descriptions and those showing details of technique are excellent and materially aid the reader in grasping the subject. Most of these illustrations are merely more artistic reproductions of the illustrations which appeared in *L'Anesthésie Regionalé* by Pauchet, Sourdat, and Labat. The entire work is strictly modern in every way and should be in the hands of those desiring to practice regional anæsthesia.

David C. Straus.

[1] Montaigne and Medicine. By James Spottiswoode Taylor, M.D., F.A.C.S. New York: Paul B. Hoeber, 1922.

[2] Artificial Limbs and Amputation Stumps; A Practical Handbook. By E. Muirhead Little, F.R.C.S. (Eng.) Philadelphia: P. Blakiston's Sons & Co., 1922.

[3] Regional Anæsthesia: Its Technique and Clinical Application. By Gaston Labat, M.D. With a foreword by William J. Mayo, M.D. Philadelphia and London: W. B. Saunders Company, 1922.

AMERICAN COLLEGE OF SURGEONS

FURTHER ENDORSEMENT OF HOSPITAL STANDARDIZATION IN CANADA

FROM the time of its inception, the standardization program of the College has received hearty endorsement in Canada. Each succeeding year has witnessed a progressive increase in the number of Canadian hospitals meeting the minimum standard. At the close of the 1922 survey, out of 60 general hospitals in Canada having one hundred or more beds, 50, or 83.3 per cent, were found to meet the requirements of the College; of the 73 hospitals having from fifty to one hundred beds, 36, or 49.3 per cent, met the standard, and grouping together the 133 hospitals having over 50 beds, there were 86, or 64.6 per cent, on the approved list. This figure exceeds by 2.1 per cent the percentage of approved hospitals in the United States.

In 1921 the Canadian Medical Association officially went on record as endorsing the program of the College. In November, 1922, similar action was taken by two other organizations influential in hospitals and public health matters in Canada.

The Dominion Council of Health held a convention in Ottawa on November 30, 1922. This organization is composed of experts from the different provinces with the Deputy Minister of Health as Chairman. The following resolution was passed by this Council:

"WHEREAS the American College of Surgeons, composed of over six thousand of the leading surgeons of Canada and the United States, is international in character and in functions:

"AND WHEREAS this organization has initiated, developed and carried out an invaluable constructive program for the betterment of our hospitals; and Whereas this program has, even in so short a time, effected an enormous improvement in the professional services of our hospitals;

"BE IT RESOLVED that we, The Dominion Council of Health, meeting in Ottawa this 30th day of November, 1922, representing the different provinces of the Dominion, wish to give our endorsation and approval to this great life-saving movement, leading as it is to greater efficiency and the general improvement in hospital service, and further, we hope that this work will be continued until every hospital in Canada, regardless of its size, meets the requirements of the standardization of hospitals."

During the same month the Western Canada Hospital Association assembled in Winnipeg. Hospital standardization was one of the chief topics of discussion at this meeting. The following resolution, which is characteristic of the attitude of this organization, was passed by unanimous consent:

"WHEREAS the American College of Surgeons, composed of over six thousand of the leading surgeons of Canada and the United States, is international in character and in functions:

"AND WHEREAS this organization has initiated, developed, and carried out an invaluable constructive program for the betterment of our hospitals:

"AND WHEREAS this program has even in so short a space of time effected an enormous improvement in the professional services of our hospitals:

"BE IT RESOLVED that we, The Western Canada Hospital Association, assembled here in convention, representing the four Western Provinces of Canada, namely,—Manitoba, Saskatchewan, Alberta and British Columbia—again reiterate our very hearty endorsation of this great work and service, unparalleled in the history of hospitals and leading to such improved efficiency; and we hope that such work may be continued and carried on actively in the future as in the past, till every hospital in Canada, regardless of size or type, meets the requirements:

"AND FURTHER, BE IT RESOLVED that this Association, as well as each of its component units, pledge themselves to render all the assistance possible to those charged with the duty of carrying on such an important and excellent work."

NORTH AND SOUTH CAROLINA STATE SECTIONAL MEETING

THE sectional meeting for the states of North and South Carolina was held in Columbia, South Carolina, on February first and second, with headquarters at the Jefferson Hotel. The arrangements were in charge of a local committee with Dr. Julius H. Taylor as chairman. The hospital conference was conducted in the ballroom of the hotel at 2:00 o'clock on the first afternoon. There was a good attendance of hospital superintendents, those interested in hospital work, and Fellows of the College. The round table conference was conducted by Mr. Robert Jolly, superintendent of the Baptist Hospital, Houston, Texas. At the meeting of the Fellows an outline of the work of the College illustrated with lantern slides was given by the Associate Director. The public meeting was held in the Baptist church and was well attended. An address of welcome was delivered by the Governor of the state, and in addition to addresses by various representatives of the College, the following papers were presented:

Some Facts about Cancer. Carl A. Hamann, M.D., Professor of Applied Anatomy and Clinical Surgery, Western Reserve University School of Medicine, Cleveland, Ohio.

Experimental Medicine from a Surgical Standpoint. John Wesley Long, M.D., Emeritus Professor of Gynecology and Pediatrics, Medical College of Virginia, Greensboro, North Carolina.

History of Anæsthesia and Anæsthetics. Stuart McGuire, M.D., President and Professor of Surgery, Medical College of Virginia, Richmond, Virginia.

Better Hospitals. Rev. C. B. Moulinier, S.J., President, Catholic Hospital Association.

How You Can Aid Your Hospital? Mr. Robert Jolly, Superintendent, Baptist Hospital, Houston, Texas.

On the second day, beginning at 9 o'clock in the morning, with an intermission for lunch, the following scientific papers were read:

The Treatment of Certain Types of Goiter. Stuart McGuire, M.D., Richmond, Virginia.

Intestinal Obstruction. Carl Hamann, M.D., Cleveland, Ohio.

The Value of Enterostomy in Intestinal Obstructions. John Wesley Long, M.D., Greensboro, North Carolina.

Acute Intestinal Obstruction. J. E. Stokes, M.D., Salisbury, North Carolina.

Case Reports on Intestinal Obstruction. J. R. Young, M.D., Anderson, South Carolina.

Occlusion of Mesenteric Vessels. J. W. Tankersley, M.D., Greensboro, North Carolina.

Intestinal Obstruction. J. F. Highsmith, M.D., Fayetteville, North Carolina.

Multiple Diverticula of the Jejunum with Case Report. E. S. Boice, M.D., Rocky Mount, North Carolina.

The Army, Its New Organization and Our Duty as Surgeons and Citizens. Henry W. DeSaussure, M.D., Charleston, South Carolina.

Gastric and Duodenal Ulcer. Numa D. Bitting, M.D., Durham, North Carolina.

Corrective Surgery of the Foot. W. F. Cole, M.D., Greensboro, North Carolina.

A Few Excursions into Pulmonary Surgery. W. P. Herbert, M.D., Asheville, North Carolina.

Injury of the Common Carotid Artery and Internal Jugular Vein, Ligation, with Recovery. C. S. Lawrence, M.D., Winston-Salem, North Carolina.

Ocular Evidence of Intracranial Lesions. H. H. Briggs, M.D., Asheville, North Carolina.

Postoperative Treatment of Prostatectomy. Charles A. Mobley, M.D., Orangeburg, South Carolina.

The Origin, Circulation, and Absorption of Cerebrospinal Fluid and Its Importance in Intracranial Injuries. Addison G. Brenizer, M.D., Charlotte, North Carolina.

Regional and Spinal Anæsthesia. C. W. Rakestraw, M.D., Chester, South Carolina.

Cancer, Its Origin and Treatment. Julian M. Baker, M.D., Tarboro, North Carolina.

The Cancer Problem. Samuel Orr Black, M.D., Spartanburg, South Carolina.

Left Subphrenic Abscess Communicating with Right Side of Pelvis. G. T. Taylor, M.D., Greenville, South Carolina.

There was a good attendance at all sessions and the Columbia meeting may well be reckoned as one of the most successful meetings held this year. A great deal of credit is due to the local committees for their efforts.

College Activities During February

A meeting of the local Fellows of the College interested in the erection of the Murphy Memorial building at headquarters was held in New York on February eighth, at 4:30 p.m., at the Waldorf-Astoria. There was a good attendance and arrangements were made to push the Murphy campaign vigorously as the time has almost arrived when the building operations must be begun. A short address illustrated with lantern slides was given by the Director General.

At 10:00 a.m. on February ninth a meeting of the executive committee of the Board of Regents was held at the Waldorf-Astoria, New York, at which much important business was transacted. Following this meeting the officials present were entertained at luncheon on board the S. S. Vandyck by Mr. Williams, local manager of the Lamport & Holt Line.

The hospital standardization work of the College for 1923 is well under way. At the present time there are five visitors in the field and three more will begin hospital rounds within a few weeks. It is the desire of the College this year to visit all general hospitals having a capacity of fifty or more beds. This will include revisiting the hospitals previously approved or otherwise.